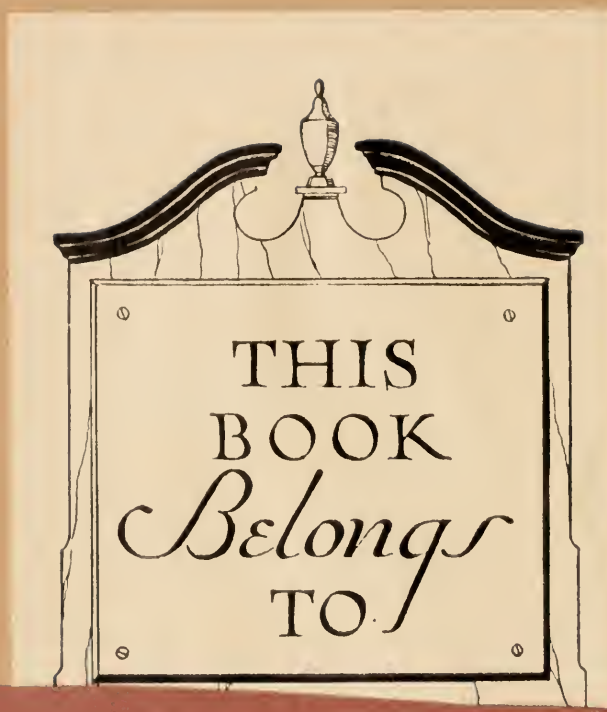
SHOUT
SHARE
IT


THIS
BOOK
Belongs
TO

Conn, Herbert William

A preliminary report on the protozoa of the fresh waters of Connecticut 1905

MBL/WHOI

0 0301 0047341 9

State of Connecticut

PUBLIC DOCUMENT No. 47

State Geological and Natural History Survey

COMMISSIONERS

HENRY ROBERTS, Governor of Connecticut *(Chairman)*
ARTHUR TWINING HADLEY, President of Yale University
BRADFORD PAUL RAYMOND, President of Wesleyan University
FLAVEL SWEETEN LUTHER, President of Trinity College *(Secretary)*
RUFUS WHITTAKER STIMSON, President of Connecticut Agricultural College

SUPERINTENDENT

WILLIAM NORTH RICE

BULLETIN No. 2

HARTFORD PRESS
The Case, Lockwood & Brainard Company
1905

A PRELIMINARY REPORT

ON

THE PROTOZOA OF THE FRESH WATERS OF CONNECTICUT

By

HERBERT WILLIAM CONN, Ph.D.,

Professor of Biology in Wesleyan University

Hartford Press

THE CASE, LOCKWOOD & BRAINARD COMPANY

1905

A Preliminary Report on the Protozoa of the Fresh Waters of Connecticut.

By H. W. Conn, Ph.D.,

Professor of Biology, Wesleyan University.

INTRODUCTION.

In connection with the State Geological and Natural History Survey, I have been requested to undertake the study of the microscopic life in the waters of the State. This part of the State Survey is naturally a very extensive piece of work, and at the present time only the beginnings of the task can be reported.

The work, as it has come into my hands, has divided itself into three parts.

1. The Protozoa.
2. The Algae and allied plants.
3. The Bacteria common in the waters of the State.

Work upon all three of these divisions of the subject has been undertaken, and is progressing satisfactorily. Up to the present time most of my own attention has been given to the study of the Protozoa. This part of the work has been carried on extensively since its assignment to me, and has reached a point where it is deemed wise to present a preliminary report upon the work already done.

Hitherto a comparatively small amount of study has been given to the Protozoa in American waters. The only extensive contributions to the studies of our Protozoa have come from Stokes* and Leidy.† In addition there have been a number of isolated publications upon the various genera and

* A Preliminary Contribution toward a History of the Fresh Water Infusoria of the United States. Journ. Trent. Nat. Hist. Soc., I, 1888.

† Fresh Water Rhizopoda of North America, Washington, 1879.

species. Prof. Stokes' valuable papers are, at present, somewhat difficult to obtain, and very difficult to follow, because of the lengthy and somewhat obscure descriptions that are given of his different species. His figures, however, are usually satisfactory, and make it possible for a student to identify his species, comparing them with forms which may be under examination. Besides the works of Stokes and Leidy there are only a few scattered papers describing isolated genera and species found in America. This dearth of work makes the study and description of American types of Protozoa especially desirable, in order that there may be in the hands of microscopic students a complete description of the types of Protozoa which are liable to be found in American waters. Such a publication does not, at present, exist. Prof. Stokes' papers have described only newly discovered species, and have never attempted to give any descriptions of forms which he simply identified and which have been described elsewhere. The literature upon Protozoa is in general so widely scattered that it is not accessible in any convenient form to the student of American microscopy. It is, therefore, a great desideratum that the description of all types of American Protozoa should, if possible, be collected and published together for the use of American students. A description of Connecticut species will not, of course, completely fill this need, but will come nearer to it than any previous publication.

For these reasons it has seemed to me that before it is possible to attempt a study of the distribution of Protozoa in the waters of the State, or of any problems associated with their economic relation to the purity of drinking waters, considerable preliminary work must be done which shall include a study and description of the genera and species found in this region. This part of the work has occupied most of my attention during the past year.

The time that it has been possible to put upon the work during the last year has been sufficient to accumulate a large amount of data upon this general subject, and it is probable that I have now obtained and had an opportunity of studying most of the genera of Protozoa liable to be found in Connecticut. This is certainly true of the two groups, FLAGELLATA and INFUSORIA.

Upon the rarer groups, RHIZOPODA, HELIOZOA, and SUCTORIA, my work is less complete, and the forms already found probably do not constitute so large a proportion of the whole as in the other two groups.

It is, of course, perfectly evident that even this preliminary work is not yet complete. It will require a long-continued study of the waters of the State before a complete list and description of all the Protozoa can be given. Before this can be regarded as complete it will doubtless be necessary to obtain the coöperation of microscopists in other localities in collecting material and possibly studying the same. The completion of the work can therefore only be made after some years of study. For this reason it is thought to be wise to publish at the present time a preliminary report upon the Protozoa already found, in order that such a report may be used to stimulate the study of this group by other microscopists in the State, and thus increase the amount of work that can be done and the territory that can be covered. The present report is designed, therefore, simply as introductory, and its purposes are, 1st, to state the progress that has been made in the study of the Protozoa, and 2d, to elicit the coöperation of other microscopists so far as possible. It is hoped, therefore, that microscopists into whose hands this preliminary report may fall and who may be interested in the study of the microscopic life of our waters, will communicate with the author of this paper, in order that, if possible, coöperative work may be started in various parts of the State. The author would be very glad to receive communications from any one within the limits of the State who is interested in microscopic study, and especially to obtain material for study that anyone will be kind enough to send to his laboratory in Middletown.

It is expected that, at a later time, a more complete report of the Protozoa of the State will be published, which, it is hoped, may take the form of a general scientific study of the unicellular animals and their evolution, as illustrated by the forms found in our own waters. Such a study is not feasible at present. The present report is planned with the object of making it as useful as possible to microscopists. Therefore it has been regarded as wise to illustrate carefully all species

found. In the study of Protozoa careful figures are always of more value to the microscopist than specific descriptions, because of the difficulty in studying the animals and tracing out minute details. It frequently happens that one can easily recognize a species from its appearance, when it would be impossible to determine the characters upon which the species or even the genus is based. In the study of a rapidly moving microscopic animal it is often impossible to make out minute details, and points in internal structure, — like the nucleus and vacuoles — cannot, in many cases, be decided upon in the living specimens. In all such cases the general appearance of the animals is of more use in determination than specific descriptions. For this reason there is given, in the present report, a figure of every species of animal thus far thoroughly identified, and, in some cases, two or three figures of the same type are given where specimens show considerable variations from each other. The figures are all original, and drawn by the author from the actual specimens.

The *key* printed in this preliminary report is designed for the use of working students, and is not intended to indicate any real relations of the organisms in question. The problem of the general relations of the groups will be discussed when a more complete report of the Protozoa may be prepared. This key is based upon one which has been found most useful to the author, namely, the one published by Kirchner and Blochmann.* The key, as printed in the following pages, follows in general the one devised by these authors. It has, however, been much modified, to make it clearer and more useful to a beginner. Inasmuch as quite a number of genera are clearly present in our waters which are not included in the above-mentioned key, it has been found necessary to add these new genera to the key. It is believed, therefore, that our key is an improvement over any before published. This key includes all the genera known to occur in fresh water, whether they have yet been detected in Connecticut or not, and, consequently, all that are likely to be found in our State.

* Die Mikroskopische Pflanzen- und Thierwelt des Süsswassers, Braunschweig, 1886.

Following the key I have given brief diagnostic descriptions of the determined *genera*. In these descriptions I have also followed the plan of Kirchner and Blochmann, in including only the essential characters, leaving out the subordinate details which are liable to confuse the student rather than aid in identification. In the description of the genera only those are described in this preliminary report which have already been actually identified by myself, as occurring in our waters. There are doubtless other genera in Connecticut, which will be found later, and their descriptions will be given in subsequent reports.

I have found several types of Protozoa existing in our waters, sometimes in considerable abundance, that do not agree with any described genera. Whether to regard these as new genera or modified forms of described genera I am as yet uncertain. In this preliminary report they are called *new genera*, and descriptions are then given. No attempt is made at present to give them names, for I regard it preferable to reserve the final descriptions and the naming of such types until a later report, when a longer period of study may enable me to determine more accurately whether these genera are connected by intermediate grades with any of the types already described, or whether they should be regarded as really new.

Descriptions of *species* are wholly omitted in this report. The Protozoa are known to be widely variable, and it is, therefore, always a matter of great difficulty to determine where to draw the limits between species. Two different attitudes toward this question may be adopted. One is to describe each distinguishable type as a separate species, and the other to group large numbers of closely allied forms together under the name of one species, even though they show wide variations. The latter method appears to me, on the whole, preferable; but if it is to be done, it can only be done after a long study of the different varieties that may be found, a study much more extended than it has been possible as yet to give to the subject. Moreover, the specific descriptions of Protozoa are so widely scattered in literature that it is a great task to obtain them all. Up to the present time I have not been able to search all this literature, in order to identify all the species

which I have found. Wherever I have been able clearly to identify the specific names, or the probable specific names, of the animals described, I have given these names in the following report, but in cases where I have not yet determined the species I have always indicated it by the sign *sp* (?). Some of the species thus marked are doubtless new species. It has been evident in the course of the study that it is possible to create many *new species* out of the types found in Connecticut, if it is so desired. But in the present report it is not thought wise to do this. In the later report the discussion of the question of species will be given more thoroughly.

The figures which accompany this report are drawn to scale, so as to be directly comparable in size. In the RHIZOPODA and INFUSORIA, Plates I-V and Plates XI-XXXIV, the figures are all magnified 500 diameters, except in a few cases where otherwise noted. In the FLAGELLATA, Plates VI-X, the figures are magnified 1,000 diameters, unless otherwise stated. A few very large animals could not be so highly magnified, and where such is the case the amount of magnification is stated on the figure. There is a certain disadvantage in drawing to the same scale figures of animals differing so widely in size, since it makes it impracticable to arrange figures on the plates in their proper order in all cases. Using the same scale, also, makes some figures unnecessarily large and others too small for the best results. But the practical advantage to the student of learning directly from the figures the relative size of all the animals figured is very great. This advantage of being able to determine the relative sizes at a glance, rather than needing to make a calculation for the purpose, has appeared to me to offset very decidedly the disadvantages that come from using figures of such varying sizes.

Nearly all the specimens described in this paper have been found in the waters of Middletown. Collections of materials have also been made from other localities in the State, and many of the species described have been identified elsewhere. A few of the specimens described have been found in other towns, but not yet in Middletown, although probably nearly all types of Protozoa will be found more or less uniformly distributed over the State. This question of *distribution* will not,

however, be considered in this preliminary report. The waters which have furnished the specimens have been largely drinking waters of Middletown and other cities, although a considerable amount of material has been obtained from brooks and rivers, road-side pools, and even watering troughs.

THE PROTOZOA.

The Protozoa are divided into classes, as follows:

1. Animals partly free, partly attached, with pseudopodia, flagella, or cilia 2
   Animals, when adult, attached usually by a stalk; the free portion provided with a small number of stiff knobbed projections, which can be withdrawn, called tentacles .....SUCTORIA p. 65
2. Adult animals with pseudopodia 3
   Adult animals with flagella or cilia 4
3. Pseudopodia of variable form; sometimes with a shell either homogeneous or made of plates, sand grains, etc .....RHIZOPODA p. 11
   Pseudopodia stiff, finely thread-like, seldom branched or anastomosing, arranged radially around the spherical body; sometimes with an envelope of jelly, or a skeleton of silicious needles .....
   HELIOZOA p. 17
4. With 1-2, rarely 3-4, long flagella, and one nucleus
   MASTIGOPHORA p. 19
   With a large number of cilia and one or more nuclei .....CILIATA p. 39

CLASS RHIZOPODA.

Key to Genera.

1. No shell 2
   With a shell 9
2. Pseudopodia lobe-like 3
   Pseudopodia fine, reticular, arising in groups .....
   Gymnophrys
3. No nucleus 4
   With nucleus 5

4. Without contractile vacuole.....*Protamœba?*†
   With contractile vacuole.....*Gloidium?*†
5. One pseudopodium directed forwards .....*Hyalodiscus**
   Pseudopodia more than one 6
6. Pseudopodia finger-like, from the border only, or from one or few parts of the spherical body 7
   Pseudopodia various but from all sides of the body .. 8
7. Discoidal; pseudopodia radiating from all sides .... *Dactylosphærium*
   Spherical; pseudopodia from one spot; commonly violet .....*Amphizonella*
8. Pseudopodia many, lobe-like, from all sides of the body .....*Amœba**
   Pseudopodia many, fine, membrane-like; ectosarc reddish .....*Plakopus*
   Pseudopodia few, very broad; animals large..... *Pelomyxa**
9. Pseudopodia finger-like 10
   Pseudopodia thread-like 18
10. Shell chitinous, colorless or yellowish, with a structure only visible with high powers..... 11
    Shell with evident structure, either secreted by the animal or made of foreign bodies 15
11. Shell watch-glass shape: pseudopod opening on under side 12
    Shell ellipsoidal, compressed, structureless *Hyalosphenia*
12. Shell hyaline 13
    Shell showing hexagonal markings 14
13. Pseudopod opening large, not closed by a membrane; pseudopods many .....*Cochliopodium*
    Pseudopod opening closed by a membrane as far as the pseudopodia: shell flexible.....*Pseudochlamys*
    Pseudopod opening narrowed by an evident border *Pyxidicula*
14. With a variable number of spines .....*Centropyxis**
    Without spines; shell yellow or brown .....*Arcella**
15. Shell made of sand grains, diatom shells, etc. ..... *Difflugia**

* Genera already found in Connecticut and described in the following pages.
† Doubtful genera.

Shell chitinous with a few grains of sand at one end *Heleopera*
Shell with no sand grains 16
16. Body spiral .....*Lecquereusia**
Body not spiral 17
17. Shell made of four-sided plates; pear-shaped..*Quadrula**
Shell of round, irregular, chitinous plates; compressed; with a two-lipped mouth .....*Nebela*
18. Shell with one pseudopod opening 19
Shell with two pseudopod openings 27
19. Shell with evident structure 20
Shell without evident structure 23
20. Shell made of grains of sand 21
Shell chitinous but encrusted with sand grains; retort-shaped, with two lateral processes above .... *Campascus*
Shell chitinous, without sand grains 22
21. Pseudopodia of one kind.....*Pseudodifflugia*
Pseudopodia of two kinds.....*Diaphoropodon*
22. Shell circular, compressed; mouth irregularly notched .....*Assulina*
Shell pear-shaped or spherical; compressed; made of rounded, spirally arranged plates, giving an hexagonal appearance; mouth with toothed plates.... *Euglypha**
Shell as above, but with mouth excentric .....*Trinema*
Shell with finer markings; neck bent to one side .... *Cyphoderia**
23. Solitary 24
Mostly colonial 25
24. Mouth lateral; shell thin, flexible; pseudopodia arising from a stalk in the mouth .....*Lieberkuhnia*
Mouth terminal; shell ovate to spherical, or flattened; pseudopodia partly reticular, partly branched, slightly anastomosing, and extending around the body .....*Gromia*
Mouth terminal; shell very delicate; pseudopodia not extending around the body .....*Pamphagus**
25. Shell close to the body; spherical.....*Lecythium*
Shell not close to the body 26

26. Shell delicate; body with a granular central zone; individuals united by the pseudopodia ..... *Platoum*
Shell delicate; body without central zone; with a short neck and a lateral mouth ..... *Microgromia**
27. Shell of sand grains ..... *Amphitrema*
Shell without sand grains 28
28. Shell delicate; two lateral pseudopod openings; with yellow to red oil drops ..... *Diplophrys**
Shell chitinous; with two terminal pseudopod openings ..... *Ditrema*
Shell chitinous, spherical; with many pore-like openings ..... *Microcometes*

Description of Genera.

Hyalodiscus H. & L.

Round to elongated disk-shaped; without evident pseudopodia; moving without much change in shape. Nucleus and contractile vacuole always present.

Hy. limax Duj., Figs. 2, 8.

Hy. guttula Duj., Figs. 3, 4.

Amœba Ehrbg.

Usually a sharp differentiation of ectoplasm and entoplasm. One large nucleus or many small nuclei present, and also one or more contractile vacuoles. Pseudopodia generally lobe-like, seldom branched. Reproduction by division in motile stage.

Am. proteus Leidy, Fig. 1.

Am. verrucosa Ehrbg., Figs. 5 and 6.

Pelomyxa Greeff.

With broad, sack-like pseudopodia; ectosarc apparent only in places; hyaline; entosarc vacuolated. Nuclei numerous. With fine hyaline rods, which often form a covering over the body.

Fig. 7 is, with some doubt, referred to this genus, its small size rendering its identification uncertain. It is, perhaps, only a species of *Hyalodiscus*.

Dactylosphærium H. & L.

Body round; pseudopodia ray-like, arising from all sides of the disk-formed body; short lobe-like pseudopodia,

frequently arising after the withdrawal of the ray-like pseudopodia. Nuclei and contractile vacuoles always present.

Dac. radiosum Ehrbg., Fig. 9.

Arcella Ehrbg.

Shell yellow to dark brown, watch-glass shape, curved or polyhedral. The side bearing the psudopodia flat, with central opening. The shell shows a fine hexagonal lattice-work, due to its being made of hexagonal prisms. Body substance does not completely fill the shell. Nuclei and vacuoles usually numerous. Reproduction by fission and budding.

Arc. dentata Ehrbg., Figs. 10 and 10*a*.

Arc. vulgaris Ehrbg., Fig. 11.

Centropyxis Stein.

Like *Arcella,* but armed with a variable number of spines. This genus is closely related to *Arcella,* and is commonly regarded as the same.

Cent. aculeata Stein, Fig. 13.

Quadrula F. E. Sch.

Shell pear-shaped, slightly compressed; composed of quadrilateral (silicious?) plates. Posterior end sometimes armed with spines.

Q. symmetrica Schul., Fig. 20.

Difflugia Leclerc.

Shell formed of foreign bodies, grains of said, diatom shells, etc., united by a chitinous connecting substance. Form spherical to pear-shaped; frequently with spines at the posterior end. Mouth occasionally excentric. Body not completely filling the shell; with finger-like pseudopodia. Nucleus and contractile vacuoles variable.

Dif. globosa Duj., Fig. 14.

Dif. lobostoma Leidy, Fig. 16.

Dif. pyriformis Perty, Fig. 17.

Dif. cratera Leidy, Fig. 19.

Dif. acuminata Ehrbg., Fig. 22.

Dif. corona Wall., Fig. 27.

Lecquereusia Schlumbg.

Shell of sand or specially formed bodies. Shell spirally coiled, laterally compressed, but the neck cylindrical.

Lec. (*Difflugia*) *spiralis* Ehrbg., Fig. 12.

Euglypha Duj.

Shell of round, oblique rows of plates, whose edges cross to make hexagonal areas. Shell spherical to pear-shaped. Spines frequently present. Mouth surrounded by regular teeth. Body differentiated into a finely granular posterior portion and a coarsely granulated anterior portion. Pseudopodia fine and frequently branching.

Eug. alveolata Duj., Fig. 24.

Cyphoderia Schlumbg.

Shell retort-formed, with an oblique opening, composed of five six-sided plates. Body differentiated into two divisions, the anterior containing the vacuole and the posterior the nucleus.

Cy. ampulla Ehrbg., Fig. 15.

Microgromia H. & L.

Usually united in colonies. Shell colorless, flask-formed, with short neck. Pseudopodic openings slightly to one side. Body incompletely filling the shell. Base of pseudopodia slightly lateral, with contractile vacuole at its base. Pseudopodia delicate, anastomosing, with streaming granules. Commonly forming colonies.

Fig. 21 is, with some doubt, referred to this genus.

Pamphagus Bai. (*Lecythium*, H. and L.)

Much like *Microgromia*. Shell delicate, flexible, and lying closely upon the body. Body not evidently divided into two regions. Pseudopodia delicate, without granules.

Pam. (*Lecythium*) *hyalinum* H. & L., Fig. 30.

Diplophrys Barker.

Shell spherical to ellipsoidal, with two pseudopodic openings, not exactly in the body axis. A nucleus and many contractile vacuoles present. Usually with one large, or with two or more small yellow to red fat globules. Pseudopodia in two groups, delicate, slightly branched, and not anastomosing.

Dip. archeri Barker, Fig. 29.

CLASS HELIOZOA.

Key to Genera.

1. No outer envelope 2
   Outer envelope present 6
2. Body commonly amœboid; pseudopodia either from all sides or from one place; no axial fiber 3
   Spherical; pseudopodia from all sides, with axial fiber 5
3. Ectoplasm and entoplasm not differentiated; colorless 4
   Ectoplasm and entoplasm differentiated; the first hyaline, and the latter red or brown. Commonly red cysts on algæ ..... *Vampyrella**
4. Nuclei one or more; several slowly pulsating vacuoles; solitary ..... *Nucleariа**
   Colonies of eight or less; pseudopodia with spindle swellings ..... *Monobia*
5. The vacuolated ectoplasm not sharply separate from entoplasm; central nucleus ..... *Actinophrys**
   Ectoplasm with large vacuoles, sharply separate from entoplasm; many nuclei; 1 mm. in size .....
   Actinosphærium
6. Envelope jelly-like; streaked, punctured, or folded .. 7
   Envelope of isolated silicious pieces, or a silicious shell 8
7. Envelope punctured, with fine radiating spines between the pseudopodia ..... *Heterophrys*
   Envelope of streaked appearance, lobe-like surface; colonial ..... *Sphærastrum*
8. Envelope of many layers of silicious globules .....
   Pompholyxophrys
   Envelope of loose and more or less bent silicious needles; commonly colonial ..... *Raphidiophrys**
   Envelope of leaf-like, pointed silicious plates .....
   Pinaciophora
   Envelope of radiate spines, with a basal plate .....
   Acanthocystis
   Envelope of silicious shell, with rounded openings ..
   *Clathrulina**

Description of Genera.

Vampyrella Cienk.

Ectoplasm hyaline, entoplasm usually brown or red; frequently vacuolated. Form amœboid, changeable, spherical, disk-formed, or elongated. Pseudopodia ray-like, either arising on all sides or at one point. One or more nuclei; contractile vacuole not definitely made out. Frequently there is found a gelatinous covering through which the pseudopodia protrude.

Vamp. lateritia Fres., Fig. 25.

Nuclearia Cienk.

Body spherical, disk-formed or elongated. Pseudopodia from all sides, or arising only in one place; sometimes branching. One or more nuclei, and many contractile vacuoles. Sometimes surrounded by a gelatinous envelope.

Nu. simplex Cienk., Figs. 18 and 23.

Actinophrys Ehrbg.

Usually spherical with pseudopodia on all sides, whose axial thread can be traced to the nucleus lying in the granular entosarc. The colorless ectoplasm not sharply differentiated from the entoplasm. Usually a single contractile vacuole. Multiplication by division. Occasionally colonial.

Act. sol Ehrbg., Fig. 26.

Rhaphidiophrys Arch.

Solitary or colonial. Spherical with delicate pseudopodia uniform over the body. No sharp differentiation of the body substance. Nuclei, one or more, and several contractile vacuoles. Skeleton composed of irregular, loosely bound, straight or slightly bent silicious needles, mostly tangential to the body surface and frequently raised around the bases of the pseudopodia. Colonies have a common shell. Sometimes with chlorophyll bodies.

Rhap. elegans H. & L., Fig. 31.

Clathrulina Cienk.

Animals like *Actinophrys,* without differentiation into body regions, with numerous contractile vacuoles, central nucleus, and many delicate pseudopodia frequently forked

at the end. Skeleton a silicious shell nearly spherical, containing numerous round or polygonal openings. Attached by a long, tubular stock, whose root-like base is fastened to other objects. The young shell colorless, but later brown. The animal moves freely in its shell by means of its pseudopodia.

Clath. elegans Cienk., Fig. 28.

CLASS MASTIGOPHORA.

The classification of the *Mastigophora* adopted below is essentially that of Bütschli. It does not represent genetic relationship so well as a classification adopted by Senn (Engler and Prantl, Pflanzenfamilien) based upon the type of metabolism. But the older classification, based upon the flagella, is more convenient to use and is of more practical value in the identification of types. For this reason it has been adopted in this preliminary report.

Key to Orders.

With one or more flagella, without a collar, and without a transverse furrow.....FLAGELLATA, p. 19

With one flagellum whose base is surrounded by a collar.. CHOANOFLAGELLATA, p. 38

With two flagella, one of which lies in a cross furrow, and the other in a longitudinal furrow directed backwards. Sometimes naked and colorless; sometimes with a tabulated armor, colored green, yellow, or brown by chromatophores .....DINOFLAGELLATA, p. 39

ORDER FLAGELLATA.

Key to Sub-Orders.

1. One flagellum, or several flagella, mostly directed forward 2

   Usually two flagella of different sizes, one of which is directed forwards and the other backwards.... HETEROMASTIGODA, p. 29

2. Mostly small, with one large flagellum and frequently one or more smaller secondary flagella..... MONADINA, p. 20

Larger animals, commonly with one large flagellum, sometimes with two such flagella, or with a single large flagellum and a secondary one. Mouth and commonly a pharynx at the base of the flagellum ..... EUGLENOIDINA, p. 24

With two or more equal flagella..... ISOMASTIGODA, p. 32

SUB-ORDER MONADINA.

Key to Genera.

1. Possessing both flagella and pseudopodia; readily passing into a Heliozoid stage..... 2
   Commonly without pseudopodia; with one flagellum 3
   Without pseudopodia; with one flagellum, and one or two secondary flagella..... 8
2. One evident flagellum and lobe-like or pointed pseudopodia .....*Mastigamœba**
   In flagellate stage, with one or two flagella; in Heliozoid stage, without flagella.....*Ciliophrys*
   Two flagella in both stages; pseudopodia simple, with axis fiber.....*Dimorpha*
   Two flagella in both stages; pseudopodia various, without axis fiber.....*Cercobodo**
3. Without lorica 4
   With lorica 6
4. Posterior end elongated into a tail; sometimes amœboid .....*Cercomonas**
   No tail, although sometimes narrowed posteriorly; free or attached; flagellum vibratile.....*Oikomonas**
   Body ovate, flattened, free; flagellum usually carried obliquely forward and vibratile only at its end... *Notosolenus**
6. Solitary 7
   Colonial; daughter-individuals attached to inner wall of lorica .....*Poteriodendron*
7. With a peristome process.....*Bicosœca*
   Without a peristome process.....*Codonœca*
8. Without chromatophores..... 9
   With yellow to brown chromatophores..... 13

9. Forming branching colonies..... 11
Solitary 10
10. Free, or attached by an attenuated posterior end; moderately flexible; one or two secondary flagella .....*Monas**
Free, attenuated in front; very flexible; no secondary flagellum .....*Leptomonas**
With the anterior flagellum replaced by a flexible tentacle .....*Rhynchomonas**
11. Many individuals upon the end of each branch..... 12
One individual on the end of each branch..*Dendromonas*
12. Stalk short, branching dichotomously once or twice *Cephalothamnium**
Stalk well developed; the older animals brown, granular .....*Anthophysa**
13. Colonial 14
Solitary 15
14. Lorica horny with pointed posterior end; colonies formed by growth from rim of lorica; colonies free .....*Dinobryon**
Colonies of numerous individuals in a gelatinous sphere .....*Uroglena**
15. Without lorica .....*Ochromonas**
With horny lorica.....*Epipyxis*
With a shell made of overlapping plates bearing long spines .....*Mallomonas**

Description of Genera.

Mastigamœba F. E. Sch.

Form amœboid. Ectoplasm sometimes differentiated. Pseudopodia finger-like to acute, rarely branching. A nucleus and one or more contractile vacuoles present. One prominent flagellum. Upon assuming the free swimming stage the pseudopodia disappear.

M. reptans Stokes, Fig. 32.

M. longifilum (?) Stokes, Fig. 33.

Cercobodo Krass.

Body spherical to spindle-formed, amœboid. Two flagella, of which one is trailing. Motion free or creeping

in flagellate stage, and by pseudopodia in the amœboid stage. One or two contractile vacuoles, one lying in front and the other behind; nucleus anterior.

C. mutabilis (?) Stokes, Fig. 36.

Cercomonas Duj.

Form spherical to spindle-shaped, colorless. A single long anterior flagellum. Body prolonged posteriorly into a caudal process. Pseudopodia frequently seen, particularly near the caudal process. Nucleus in anterior half of body; one or more vacuoles.

C. longicaudata Duj., Fig. 34.

C. crassicauda Duj., Fig. 35.

Oikomonas S. K.

Very small. Free swimming or attached by a protoplasmic filament. Spherical, oval, or amœboid. With one flagellum on anterior end and near by frequently a projecting lip which serves for taking food. Nucleus and contractile vacuole present.

O. sp (?), Fig. 40.

O. sp (?), Fig. 40*a*.

Notosolenus Stokes.

Oval or angular; flattened dorso-ventrally with dorsal side concave. Rigid. One long flagellum carried obliquely and stiffly in front, and a shorter one only ⅓ the length of the body directed backwards and commonly not visible. Mouth near base of flagellum. Contractile vacuole double.

N. orbicularis Stokes, Fig. 37.

N. sp (?), Fig. 38.

N. sp (?), Fig. 39.

Monas Ehrbg. Stein.

Solitary; spherical to ovate. Occasionally fastened by a delicate stalk-like posterior end. With one chief flagellum and one or secondary flagella. A mouth projection and occasionally an eye-spot present. A nucleus near the flagellum and one or two contractile vacuoles.

M. (*Physomonas*) *elongata* (?) Stokes, Fig. 41. Attached and free.

Leptomonas Kent.

Solitary, attenuated in front, very flexible, and carrying one long flagellum. Usually parasitic.

Fig. 42, representing an animal found in the water of a watering trough, is with some doubt referred to this genus.

Rhynchomonas Klebs.

Ovate, slightly compressed, the anterior end prolonged into a movable process. Slightly contractile. The single flagellum trailing. Mouth near the anterior end. Contractile vacuole anterior; nucleus central. Motions slow.

R. nasula Klebs, Fig. 65.

Cephalothamnium Stein.

Body elongated, with an obliquely truncated anterior end that forms an acute projection on one side. One chief flagellum about as long as the body, at whose base is a small secondary flagellum and a mouth. Nucleus and contractile vacuole anterior. Forming colonies in groups upon the end of a stalk, either simple or branching twice or three times.

C. cæspitosa (?) S. K., Fig. 46.

Anthophysa Bory de Vinc.

Animals as in *Cephalothamnium*. Forming spherical colonies upon the ends of a much branched stalk, the older portions of which are brownish and the younger portions colorless.

A. vegetans Stein, Fig. 47.

Dinobryon Ehrbg.

Free swimming colonies, yellow to brown. A beaker-like lorica, with an acute posterior end. The younger individuals are mostly attached with their posterior end inside of the mouth opening of the older individuals. With two chromatophores and an eye-spot. Central nucleus and one or two anterior contractile vacuoles. One primary and one secondary flagellum.

D. sertularia Ehrbg., Fig. 44.

Uroglena Ehrbg.

Free swimming, nearly spherical colonies, made of many individuals embedded on the surface of a jelly-like

mass. Individuals like *Dinobryon,* usually with two yellow chromatophores and an eye-spot. Nuclei central and an anterior contractile vacuole. One primary and one secondary flagellum.

U. americana Calk., Fig. 49. The cause of a fishy taste frequently found in reservoirs.

Mallomonas Perty.

Oval to enlongated, solitary, with a shell made up of overlapping plates bearing long spines. One prominent flagellum. Two yellowish green chromatophores, but no eye-spot. Many posterior contractile vacuoles, and an elongated anterior nucleus.

M. acaroides Perty, Fig. 58.

M. sp (?), Fig. 60. Cross section, Fig. 60*a*.

SUB-ORDER EUGLENOIDINA

Key to Genera.

1. One evident flagellum (two similar flagella in Eutreptia) 2
   One chief and one secondary flagellum..... 15
   Typically colored..... 3
   Typically uncolored..... 12
3. Naked, or with very thin cuticle..... 4
   With cuticle usually striated; flexible or rigid; sometimes with lorica or shell..... 7
4. Numerous small green chromatophores..... 5
   Two yellow or green chromatophores..... 6
5. Without trichocysts.....*Cœlomonas*
   With trichocysts.....*Goniostomum*
6. Two lateral brown chromatophores, each with one eye-spot; mouth opening and vacuole system present .....*Microglena*
   One or more yellow chromatophores; one eye-spot and many contractile vacuoles at base of flagellum *Chromulina**
   Two green chromatophores; one eye-spot..... *Cryptoglena**
7. Flexible; free swimming, with a delicate shell, or fixed in a lorica, or on a stalk..... 8

Not flexible or only slightly so; with a thick cuticle 11

8. Without a lorica 9
With a lorica 10

9. With one flagellum; both ends contracted ..... *Euglena**
With one flagellum; anterior end rounded; usually in a jelly-like envelope, and attached by a branched stalk; ectoparasites ..... *Colacium*
With two flagella ..... *Eutreptia**

10. In a beaker-shaped or tube-like lorica ..... *Ascoglena*
In a hard, smooth or spiny, spherical or cylindrical, brownish shell ..... *Trachelomonas**

11. Ellipsoidal or slightly flattened; pharynx in body axis, and a short, pointed caudal process .. *Lepocinclis**
Ellipsoidal, not flattened; with rows of tubercles and a pointed caudal process ..... *Chloropeltis**
Usually asymmetrical, flattened. Mouth on back; pharynx oblique; evident, pointed caudal process *Phacus**

12. Not flexible 13
Flexible 14

13. Elongated, somewhat crescentic; rounded posterior end ..... *Menoidium*
Straight, spindle-formed; acute posterior end ..... *Atractonema**
Cylindrical, slightly bent; both ends rounded ..... *Rhabdomonas*
Much flattened, with one or more keels upon dorsal surface; large mouth at base of flagellum. *Petalomonas*

14. Long, needle-shaped; frequently spiral ..... *Astasiopsis*
Oval, flattened; mouth at base of flagellum; an evident pharynx and a rod-like organ ..... *Peranema**
Flask-shaped; neck-like anterior end, with pharynx extending to middle; rod-like organ present ..... *Urceolus**
Like *Urceolus,* but covered with sand grains ..... *Urceolopsis*

15. Flexible 16
Not flexible 17

16. Like *Euglena* in shape and method of contraction; secondary flagellum small, close to chief flagellum *Astasia**

Oval or elongated; secondary flagellum commonly directed backwards ..... *Zygoselmis*

17. Elongated or crescentic; with four acute, longitudinal ridges, and hence nearly four-sided..... *Sphenomonas**

Like the above, but without the longitudinal ridges.. *Clostonema**

Nearly ellipsoidal, with many slightly spiral ridges.. *Tropidoscyphus*

Description of Genera.

Cryptoglena Ehrbg. = *Chloromonas* S. K.

Rigid, flattened, with two lateral green chromatophores, a single eye-spot, a mouth, and vacuole system. Nucleus posterior.

C. pigra Ehrbg., Fig. 93.

Euglena Ehrbg.

Large flagellates, spindle-formed or elongated, widely variable; usually with a strong, spirally marked cuticle. Frequently the whole animal moves with a screw-like motion. Body very flexible. Chromatophores green, either disk-shaped and numerous, or star-shaped or ribbon-like, and in small numbers; commonly without pyrenoids. In many species the animals are colored red; less frequently there are found quite colorless individuals. Mouth and pharynx evident, and a long flagellum arising from the mouth which, however, frequently drops off. At the lower end of the pharynx is a vacuole system with an eye-spot close by. Nucleus present, as well as paramylum bodies.

Eu. viridis Ehrbg., Fig. 45.

Eu. sp. (?), Fig. 50.

Eu. deses Ehrbg., Fig. 51.

Eu. spirogyra Ehrbg., Fig. 56.

Eu. sp. (?), Fig. 57.

Eu. sp. (?), Fig. 52. This animal is sufficiently flexible to bend from side to side, but does not show the peculiar

euglenoid movements of this genus. I place it here with some doubt, although it does not agree with any other genus known to me.

Eutreptia Perty.

Like *Euglena,* but with two equal flagella. When extended, body is spindle-formed and very flexible. A delicately marked cuticle. The body contains disk-formed chromatophores without pyrenoids; paramylum bodies cylindrical.

Eut. viridis Perty, Fig. 48.

Trachelomonas Ehrbg.

Animals like *Euglena;* free swimming, with a rigid spherical to ovate or cylindrical lorica which is either smooth, sculptured, or spiny. Lorica colorless, or colored red to brown. The flagella three to four times as long as the body. Disk-formed chromatophores with pyrenoids and paramylum bodies present.

Tr. lagenella (?) Stein, Fig. 53.

Tr. hispida Stein, Fig. 54.

Tr. volvocina Ehrbg., Fig. 59.

Lepocinclis Perty. = *Chloropeltis* Stein.

Ellipsoidal, round or slightly compressed, with prominent longitudinally or spirally marked cuticle, sometimes armed with spines. Near the flagellum a short tube, or a short pharynx. Posterior end acute. Paramylum bodies sometimes large and snake-like.

Lep. sp. (?), Fig. 61. This animal, found abundantly, is with some doubt referred to this genus, the short caudal extremity being unlike the typical forms of *Lepocinclis.*

Phacus Nitzsch.

Usually much flattened, asymmetrical, round to oval or pear-shaped. Commonly with a sharply differentiated, colorless, caudal process which is sometimes oblique. Mouth on the back; cuticle thick and marked by longitudinal or spiral stripes. Chromatophores and paramylum bodies disk-shaped. One flagellum, with the vacuole system and eye-spot, as in *Euglena,* and a posterior nucleus.

Ph. pyrum Ehrbg., Fig. 62.

Ph. pleuronectes Nitzsch, Fig. 63.

Ph. sp. (?), Fig. 64.

Chloropeltis

Body as in *Lepocinclis,* but with the longitudinal spirals armed with spines.

Ch. hispidula Stein-Eichwald, Fig. 55.

Menoidium Perty.

Colorless, sickle-form, with posterior end rounded; anterior end prolonged into a neck and obliquely truncated. The short side of the body thin and sharp, the long side rounded. Pharynx and vacuole system present, and a posterior nucleus.

M. tortuosa Stokes, Fig. 87. This is *Atractonema tortuosa* of Stokes, but it appears to differ from *Menoidium* only in having an acute posterior end.

Peranema Duj.

In the extended condition the body is oval, with a broad, rounded posterior end. Very flexible. A fine spirally marked cuticle. Flagellum very long, broader at its base, and vibrating chiefly at its tip. A mouth opening behind the flagellum which extends into a short, tube-shaped pharynx. A peculiar rod-like organ back of the mouth. Vacuole system at base of the flagellum, and a central nucleus.

Only one species of this genus has been hitherto described, but the different forms shown below evidently belong to this genus, and show too great variations to warrant putting them under one species.

P. trichophorum Ehrbg., Fig. 74.

P. sp. (?), Fig. 70.

P. sp. (?), Figs. 71 and 71*a*.

P. sp. (?), Fig. 72.

Urceolus Meresch.

In an extended condition body somewhat flask-shaped, with a contracted neck; posterior end rounded; anterior end forming a funnel-shaped peristome from which the flagellum protrudes and which extends into a pharynx reaching to the posterior third of the body. A rod-like organ present as in *Peranema.* Nucleus and contractile vacuole present.

U. cyclostomus (?) Stein, Fig. 69.

Astasia Stein.

Body elongated, spindle-formed, very flexible, spirally striated or smooth. Mouth and pharynx evident, as in *Euglena.* Close beside the large flagellum a very small secondary flagellum. Nucleus and contractile vacuole present.

As. sp. (?). Fig. 73, is probably *Astasia,* although the secondary flagellum was not evident.

As. contorta (?) Duj., Fig. 103.

Sphenomonas Stein.

Not flexible; body ellipsoidal with four strong keels, giving the body a somewhat four-sided cross section. A chief and a secondary flagellum and a pharynx present. See *Clostonema* below.

Clostonema Stokes.

Fusiform to elongate, not contractile. Two unequal flagella, one carried forward and the other backward. Pharynx present. Contractile vacuole double; anterior nucleus central.

Cl. socialis Stokes, Figs. 88 and 90. This is regarded by Senn as belonging to the genus *Sphenomonas* of Stein, but the absence of keels seems to separate the two, and I have, therefore, retained Stokes' genus, *Clostonema.*

SUB-ORDER HETEROMASTIGODA

Key to Genera.

1. Small animals sometimes showing amœboid motions; no evident cuticle 2
   Larger and possessing a cuticle; body frequently flattened 7
2. Flagella two 3
   Flagella three ..... *Elvirea**
3. Both flagella directed forwards ..... *Dinomonas**
   One flagellum directed backwards, trailing 4
4. Anterior end oblique; mouth at base of flagella .... *Phyllomitus**
   Body spiral ..... *Spiromonas**
   Body neither oblique or spiral 5

5. Trailing flagellum in a furrow; motile flagellum terminal ..... *Colponema*
   Trailing flagellum not in a furrow..... 6
6. Food taken in by a dorsal vacuole..... *Pleuromonas**
   Food not taken in by a dorsal vacuole..... *Bodo**
7. Trailing flagellum in a mouth furrow, extending in a curve around the end and passing backwards on the right side of body; body not flexible.. *Anisonema**
   Like *Anisonema,* but with flexible body..... *Metanema**
   Like *Anisonema,* but with trailing flagellum more posterior ..... *Heteronema**
   Like *Anisonema,* but with the trailing flagellum close to the motile flagellum, and with a very evident, partly protrusible pharynx..... *Entosiphon**

Description of Genera.

Bodo Ehrbg. = *Heteromita* Stokes.

Small, without a lorica; pear-shaped to spindle-shaped, with one flagellum directed forward, and a trailing flagellum. Mouth at base of flagellum. Pharynx frequently developed. Nucleus and contractile vacuole present. Many species assume an amœboid stage.

Stokes has described a large variety of forms under the name *Heteromita,* that must be classed with this genus. Many of his species I have identified as very common in our water.

B. ovata Stokes, Fig. 77.

B. sp. (?), Fig. 78.

B. globosa Stokes. Figs. 79 and 96 perhaps represent different species.

B. variabilis Stokes, Figs. 82-85.

B. acus Stokes, Fig. 86.

Pleuromonas Perty.

Kidney-shaped to spherical, slightly amœboid. One anterior flagellum and a second in the middle of the ventral depression. Contractile vacuole anterior, nucleus posterior. Frequently attached by the posterior flagellum. Food absorbed by a dorsal vacuole.

Pl. jaculans Perty, Fig. 66.

Dinomonas Kent.

Agreeing with *Bodo* in most respects. In moving both flagella are carried forward.

D. vorax (?) Kent, Fig. 67.

Phyllomitus Stein.

Ovate, elongate, very flexible. A prominent mouth opening in front; with two flagella, one directed forward, the other backward. One anterior, contractile vacuole; nucleus anterior. Motions quick.

Ph. amylophagus (?) Kleb., Fig. 68.

Spiromonas Perty.

Body elongated and spirally twisted. Both flagella arise in front, one of them trailing.

The genus *Spiromonas* of Perty is insufficiently described for identification. Our specimen is certainly not the one described by Perty, but would seem to be properly placed in the genus *Spiromonas.*

S. sp. (?), Fig. 110.

Elvirea Parona.

Ovate to elongate, laterally compressed. Three flagella, the middle one the shortest, the other two trailing. Mouth and nucleus anterior.

El. cionæ Parona, Fig. 100.

Anisonema Duj.

Body generally nearly oval, flat and asymmetrical, rigid. The ventral side with a depression extending toward the right, which is guarded by a lip on its right-hand border. The motile flagellum arises from the middle of the anterior end, and behind it is a mouth-opening leading into a long pharynx. The prominent trailing flagellum arises on the left side in the mouth depression, and extends around the front end in a curve, to pass backward upon the right side of the above-mentioned lip. Vacuole system anterior and nucleus further back.

A. acinus Duj., Fig. 80.

A. sp. (?), Figs. 75, 76.

Metanema Klebs.

Like *Anisonema,* but with body flexible.

M. sp. (?), Fig. 81.

Heteronema Duj.

Like *Anisonema,* but with second flagellum larger and point of origin somewhat more posterior; body with oblique mouth depresison.

H. sp. (?), Fig. 94. Fig. 94*a* is side view. Of the generic identification of this animal I am in doubt.

Entosiphon Stein.

Similar to *Anisonema.* Ventral side with a strong medial furrow. Both flagella arise in a slight depression in the anterior end. The trailing flagellum is directed backwards and is not so well developed as in *Anisonema.* Pharynx very long, extending to the hind end of the body; protrusible. Contractile vacuole, secondary vacuoles, and a nucleus present.

En. sulcatus Duj., Fig. 89.

SUB-ORDER ISOMASTIGODA

Key to Genera.

1. Solitary 2
   Colonial 19
2. Uncolored 3
   Colored 11
3. With two flagella 4
   With four flagella 7
4. Body laterally expanded into two wings, each with a flagellum ..... *Trepomonas**
   Body not laterally expanded 5
5. Body sometimes attached by a stalk; not flattened, and with no cuticle ..... *Amphimonas**
   Body never attached by a stalk; with a cuticle 6
6. Body much flattened, anterior end oblique; pharynx not evident ..... *Cyathomonas**
   Body less flattened, and with an evident pharynx .... *Chilomonas**
   Body ellipsoidal, not flattened; pharynx not evident, but with a well-developed cuticle ..... *Polytoma**
7. With a deep ventral furrow ..... *Collodictyon*
   Without ventral furrow 8

8. Body in a lorica, oval.....*Tetraselmis*
Body not in a lorica..... 9
9. With an evident peristome.....*Tetramitus*
Without evident pharynx..... 10
10. With three flagella carried forward, the other trailing *Trichomastix**
With four anterior flagella and two flagellum-like processes at posterior.....*Hexamitus**
11. With two flagella..... 12
With four flagella.....*Carteria*
12. Attached to a stalk, or in a lorica..... 13
Free swimming..... 14
13. Upon a long stalk, with two brown chromatophores *Stylochrysalis*
Urn-shaped lorica; attached to algæ.....*Chrysopyxis*
14. With band-shaped, brown chromatophores 15
With green chromatophores..... 16
15. Broad kidney-shaped; flagella in an anterior furrow; one chromatophore; movement lateral.... *Nephroselmis*
Elongated, acute posteriorly; two chromatophores and a thick cuticle; pharynx not evident *Ochromonas**
Elongated, laterally compressed, with evident pharynx *Cryptomonas**
16. Spherical 17
Not spherical..... 18
17. With delicate, closely attached cuticle; spherical to elliptical; one chromatophore.....*Chlamydomonas**
With delicate cuticle, separate from the mass of the body .....*Hæmotococcus**
With rough cuticle, separate from the mass of the body .....*Coccomonas*
18. Lenticular, with a two-valved cuticle.....*Phacotus*
Elongated, spindle-shaped; two ribbon-like chromatophores .....*Chlorangium**
Spindle-shaped; body uniformly green....*Chlorogonium*
19. Uncolored 20
Colored 21

20. Colonies gelatinous, thread-like, discoidal or round, hollow or sack-like.....*Spongomonas*
Colonies of dichotomously branching tubes..*Cladomonas*
Colonies of many closely approximating, jelly-like tubes .....*Rhipidodendron*
21. With two brown, band-like chromatophores..... 22
With green chromatophores..... 23
22. Spherical swimming colonies; cuticle sometimes spiny *Synura**
Like the above but with a common jelly covering... *Syncrypta*
23. Colonies commonly spherical..... 24
Colonies not spherical..... 25
24. Colonies of sixteen (rarely thirty-two) radially arranged individuals, their inner ends reaching the center .....*Pandorina**
Colonies of sixteen individuals, separate from each other, and lying near the wall of the jelly sphere.. *Eudorina*
Colonies of very numerous individuals in a sphere.. *Volvox*†
25. Colonies of eight equatorially arranged individuals.. *Stephanosphæra*
Colonies somewhat ellipsoidal, of sixteen individuals, in four rows around a longitudinal axis..... *Spondylomorum**
Colonies of four to sixteen individuals in a flat plate *Gonium*

Description of Genera.

Amphimonas Duj.

Spherical to oval, or triangular. Posterior end elongated into a thread-like stalk, which may be attached. Two equal flagella arise at the anterior end close together

†*Volvox* is frequently included among the FLAGELLATA, and certainly shows resemblances to some of the genera belonging to this class. I have, therefore, included it in this key, although I regard it as more closely related to the ALGÆ. Its description will be reserved for the paper upon the ALGÆ, which will appear later.

or far apart. One or two contractile vacuoles and a nucleus.

Am. sp. (?), Fig. 117. This is a form found very abundantly, but, so far as seen, never attached as in the typical species of *Amphimonas*. The two equal flagella would seem to place it here.

Trepomonas Duj.

Somewhat spherical or flattened, with two mouths on opposite sides of the body. The two sides are prolonged into wings projecting posteriorly. These wings are contracted near the body so that a cross section of the animal is in the form of an S. In the anterior end of each wing arises a long flagellum directed forward; also three very small secondary flagella. Nucleus anterior, contractile vacuole posterior.

T. agilis Duj., Fig. 115.

Cyathomonas From.

Much flattened, somewhat oval, with an obliquely truncated anterior end, bearing two equal or nearly equal flagella. Parallel with the anterior border is a row of highly refracting bodies. Contractile vacuole anterior, nucleus central.

Cy. truncata From., Fig. 111.

Cy. sp. (?), Fig. 112. The lower figure shows a side view.

Chilomonas Ehrbg.

Somewhat oval, contracted posteriorly; laterally compressed. Anterior end obliquely notched. Upon the upper side of the notch arise two flagella. The mouth leads into a tube-like pharynx extending to the middle of the body. Colorless, with an anterior contractile vacuole and a posterior nucleus.

Ch. paramecium Ehrbg., Fig. 91. An extremely common species.

Ch. sp. (?), Fig. 95. A smaller type with differently shaped body, far less common than the first species. It may be only a variety of the more common species.

Polytoma Ehrbg.

Mostly ellipsoidal, with a delicate shell and two flagella; colorless; occasionally a slightly colored eye-spot.

At the base of the flagellum two contractile vacuoles. Nucleus posterior; usually with many starch grains in the posterior part of the body. Multiplication by fission (inside of the shell) into four or eight parts which then become free.

P. uvella Ehrbg., Fig. 101.

Hexamitus Duj.

Body ellipsoidal, somewhat flexible. The anterior end rounded or acute, with two flagella. The posterior end either truncated or prolonged into two thread-like caudal processes. The animals appear very variable in form. Nucleus near the flagella and contractile vacuole posterior.

H. inflatus Duj., Fig. 97. Fig. 98 is probably a variety of the same, and also Fig. 113.

H. spiralis (?) Stokes, Fig. 105.

Trichomastix Bütsch.

Pear-shaped to elongated, rounded in front, acute behind. In front four flagella, of which three are usually carried close together, appearing as one, while the other is commonly carried behind as a trailing flagellum. The anterior flagella may be separated as shown in the figure.

The animal figured in Fig. 118 does not appear to resemble any described genus, but I place it here as being more like *Trichomastix* than any other genus. *Trichomastix* is described as parasitic. Our animal was found in great numbers in a watering trough.

Ochromonas Wys.

Oval to pear-shaped, amœboid. One long and one secondary flagellum. Mouth at base of flagellum. One or two yellowish chromatophores and an eye-spot. Anterior contractile vacuole and central nucleus. Free swimming or attached.

Och. sp. (?), Fig. 43.

Cryptomonas Ehrbg.

Identical in anatomy with *Chilomonas,* but with two brown or green chromatophores.

Crypt. ovata (?) Ehrbg., Fig. 99, *a, b, c.* Three varieties, possibly different species.

Chlamydomonas Ehrbg.

Spherical to cylindrical, with a delicate shell and prominent chromatophores, which form the chief mass of the body, and contain one or more spherical or ribbon-like pyrenoids. Two flagella, a nucleus, and an eye-spot, and two contractile vacuoles present. Multiplication by division, usually in a resting stage.

Chl. sp. (?), Fig. 116.

Chlorangium Stein.

In the motile condition, spindle-shaped, with two flagella, a delicate shell, and two green, ribbon-shaped chromatophores. Two contractile vacuoles at base of flagellum with a central nucleus, but no eye-spot. In passing into a resting stage it attaches itself by its anterior end and loses its flagella, but secretes a short stalk. While in resting condition, body divides into four parts which burst the shell and secrete stalks, so that a small colony arises.

Chl. sp. (?). Fig. 114 I place with doubt in this genus.

Synura Ehrbg.

Spherical colonies of about fifty radially arranged individuals. Individuals ellipsoidal with a delicate cuticle which is often covered with spines. Two brown chromatophores. Nucleus central and many contractile vacuoles. Eye-spots at the base of the flagellum. The single individuals either united by their hind end or held loosely together by means of the shell.

Sy. uvella Ehrbg., Fig. 104.

Spondylomorum Ehrbg.

Colonies of sixteen individuals which are arranged in four alternating rows. Multiplication by the division of the individuals into sixteen cells. Each individual of the colony bears four flagella.

Sp. quaternarium Ehrbg., Fig. 108. Shown in condition of multiplication at Fig. 108*a*.

Pandorina Ehrbg.

Spherical colonies (thirty-two cells) on the inside of a spherical shell. The individuals are remote from the outer shell, and each bear two flagella.

Eu. elegans (?) Ehrbg., Fig. 109.

ORDER CHOANOFLAGELLATA.

Key to Genera.

1. Solitary 2
   Colonial 3
2. No lorica ..... *Monosiga**
   With lorica ..... *Salpingœca**
3. Individuals inclosed in an irregular jelly... *Protospongia*
   Colonies rotund, or arising in a mass from a funnel-like, open jelly tube ..... *Phalansterium*
   Colonies free, of several individuals in an irregular row ..... *Hermidium*
   Many individuals on the end of a simple stalk..... *Codonosiga**
   With branched stalk, and single individuals or groups on end of each branch ..... *Codonocladium**

Description of Genera.

Monosiga S. K.

Solitary. Attached either directly or by means of a short stalk. Collar expanding in front and changeable in form.

M. ovata Kent, Fig. 106.

Salpingœca J. Cl.

Solitary individual in a lorica which assumes a variety of shapes; generally cup-shaped.

S. Steinii S. K., Fig. 92.

Codonosiga J. Cl.

Similar to *Monosiga,* but forming colonies upon the end of a simple, rather long stalk. Twenty or more individuals unite, forming a spherical group.

C. botrytis Clark, Fig. 107.

Codonocladium Stein.

Body spherical to ovate. The long stalk forming colonies with single individuals on each stalk.

Co. umbellatum Tat., Fig. 102.

ORDER DINOFLAGELLATA.

Key to Genera.

1. Without membrane surrounding the body..... 2
   With membrane surrounding the body..... 3
2. Cross furrow extending only around left side.....
   Hemidinium
   Cross furrow extending wholly around body.....
   *Gymnodinium**
3. Membrane delicate, structureless, no processes....
   *Glenodinium**
   Membrane of polygonal plates; processes, where present, small.....*Peridinium**
   Membrane of plates with long horn-like processes
   Ceratium
   Membrane showing a cross furrow near anterior end, but no processes.....*Amphidinium*

The genera *Gymnodinium, Glenodinium, and Peridinium* have been found abundantly, but I have, as yet, made no figures of them, and their description is, therefore, reserved for a later publication.

CLASS CILIATA.

Key to Orders.

1. Mouth in a spiral zone of large cilia..... 3
2. Mouth without a definite spiral zone.....
   HOLOTRICHA, p. 39
3. Adoral zone wound to the left; body also uniformly ciliate .....HETEROTRICHA, p. 53
   Adoral zone wound to the left; ventral surfaces with characteristically arranged large cilia, while the dorsal surface carries only fine cilia or none.....
   HYPOTRICHA, p. 56
   Adoral zone wound to the right, usually forming an almost complete circle.....PERITRICHA, p. 62

ORDER HOLOTRICHA.

Key to Genera.

1. Solitary 2
   Colonial .....*Maryna*

2. Without shell..... 3
   With sculptured shell made of numerous pieces: ellipsoidal .....*Coleps**
3. Cilia uniform over body..... 4
   One or two bands of cilia..... 25
   Cilia only on ventral surface..... 26
4. With delicate, uniform cilia only..... 5
   With tentacle-like processes among the cilia..... *Actinobolus*
5. Mouth without protruding undulating membrane.. 6
   Mouth with protruding undulating membrane..... 18
   Mouth wanting.....*Anoplophrya**
6. Mouth terminal or nearly so; no proboscis..... 7
   Mouth somewhat posterior to anterior end, on the ventral surface; sometimes with a proboscis..... 10
7. No evident pharynx..... 8
   With more or less evident pharynx..... 9
8. Ellipsoidal to ovate.....*Holophrya**
   Like the above, but with a posterior bristle...*Urotricha**
   Elongated, cylindrical.....*Chœnia**
   Elongated, anterior end oblique, neck-like....*Enchelys**
   Like the above, but with neck shorter and flattened.. *Spathidium**
   Short, purse shaped; mouth covering the whole oblique anterior end.....*Leucophrys*
9. With a long neck, not much flattened, not contractile *New genus*
   With a long neck, much flattened.....*Trachelophyllum**
   With a long neck, not flattened, sometimes telescopic and highly contractile.....*Lacrymaria**
   Without a neck; body spherical to ovate; pharynx long and evident.....*Prorodon**
10. With proboscis in front of mouth, very flexible..... 11
    Without proboscis..... 14
11. Mouth always open, pharynx rod-like..... 12
    Mouth commonly closed, no pharynx..... 13
12. Spherical to ovate, proboscis short, slightly flexible.. *Trachelius**
    Long, band-formed, long proboscis, very flexible.... *Dileptus**

13. Much flattened; with broad, clear border, which may be wanting on the right side; with trichocysts.. *Loxophyllum**

Somewhat flattened, but with no hyaline border, and commonly no trichocysts..... *Amphileptus**

14. Mouth anterior to middle..... 15

Mouth in middle, or posterior..... 17

15. Pharynx basket-like; body cylindrical to ovate.. *Nassula**

Pharynx not basket-like..... 16

16. Mouth crescentic; a watch-glass-shaped pigment spot near by; a ciliated lobe in pharynx..... *Ophryoglena**

Mouth surrounded by a furrow extending far backwards ..... *Fontonia**

Mouth bearing a few long cilia on its posterior left side; body slightly compressed and ovate.... *Colpoda**

17. Mouth near middle; short pharynx; peristome oblique; cilia uniform..... *Paramecium**

Mouth in middle or posterior half of right side; pharynx evident; long cilia behind the mouth.... *Conchopthirus*

18. Peristome not evident; mouth near the front..... 19

Peristome evident..... 22

19. Mouth in front of middle..... 20

Mouth near the middle..... 21

20. One undulating membrane; body ovate with anterior end slightly curved to the right; mouth lateral... *Colpidium**

Two undulating membranes, body ovate..... *Glaucoma**

Two undulating membranes, body elongated... *Dallasia**

21. With two membranes; body ovate, slightly compressed, broader behind, and with a long posterior bristle ..... *Uronema**

Like *Uronema,* but with an anterior spiral row of long cilia..... *Dexiotricha**

22. Peristome posterior to middle..... 23

Peristome not posterior to middle..... 24

23. With an evident membrane; a tuft of long bristles at the posterior end..... *Cinetochilum**

Membrane less evident, and without the long bristles *Microthorax**

24. Peristome covering the whole right side, with a large membrane ..... *Lembadion**
Peristomial furrow parallel to the right side; a very large projecting membrane in a depression on the posterior half of peristome..... *Pleuronema**
Like the above but smaller, with a shorter peristome and one or more long posterior bristles... *Cyclidium**
Like Pleuronema but inclosed in a lorica.. *Calyptotricha*
25. With a single row or large cilia..... *Mesodinium**
With two, many-rowed crowns of free cilia.... *Didinium*
With a broad, ring-like band of cilia..... *Urocentrum**
26. Pharynx not basket-like or tube-like..... 27
Pharynx basket-like or tube-like..... 28
27. With a long neck; body oval ending in a short tail.. *Lionotus**
With the anterior end hook-like and showing an evident peristome and pharynx; brownish..... *Loxodes**
28. Pharynx smooth; small..... 29
Pharynx basket-like..... 30
29. Only the anterior end and the right border ciliated.. *Ervilia*
With a middle, swollen, ciliated zone..... *Trochilia*
30. Body flat..... 31
Body not flat..... 33
31. Mouth in the anterior half..... 32
Mouth in the posterior half..... *Opisthodon*
32. Without a movable tail..... *Chilodon**
With a movable tail..... *Ægyria*
Body crenate in cross section; without a movable tail *New genus**
33. Body purse-shaped..... *Phascolodon*
Body ovate; six rows of cilia..... *New genus**

Description of Genera.

Coleps Ehrbg.

Barrel-shaped, but not always symmetrical; rigid, provided with an armor composed of single plates. The plates, arranged in zones around the body, are almost rectangular, sculptured upon their surface, on the one side

straight, and on the other side indented so as to produce openings through which cilia protrude. The anterior row of plates is toothed; the posterior row triangular, pressed together like a roof. Mouth terminal, surrounded by a row of strong cilia. Pharynx with a longitudinal striated wall, a spherical nucleus, a secondary nucleus, and a sub-terminal anus.

C. hirtus Ehrbg., Fig. 153.

Anoplophrya Stein.

Mouthless, free swimming, ovate to elongate. Nucleus band-like. Contractile vacuoles well developed. Cilia very long and uniform over the body. The animals are parasites in the intestines of various animals.

An. sp. (?). Fig. 226 represents a species of this genus found freely swimming in a watering trough. Its host being unknown, it is impossible to determine the species.

Holophrya Ehrbg.

Ovate to cylindrical; rounded at both ends. Mouth on the anterior end leading into a slightly developed pharynx. Anus terminal, body striate, with a uniform ciliation.

A large number of minute ciliates have been found belonging apparently to this genus. Their great variability makes the specific determination difficult and uncertain. Figs. 119-123 represent some of these common types, but no attempt has been made, at present, to determine the species. The genus *Holophyra* is in many cases hardly distinguishable from *Enchelys,* since the mouth is sometimes slightly excentric. Fig. 132 represents a spiral ciliate with terminal mouth that is tentatively placed here.

Urotricha Cl. & L.

Like *Holophyra,* except that it possesses a terminal posterior bristle.

U. farcta Cl. & L., Fig. 127.

Balantozoon agile of Stokes, Fig. 130, really belongs to this genus.

Chænia Duj.

Elongated, narrowed in front, contractile. Mouth terminal or sub-terminal, usually closed. No pharynx. Uni-

formly ciliate, but with longer cilia at the anterior end. One terminal contractile vacuole. Nucleus divided into small pieces.

Ch. teres Duj., Fig. 140. This is the only species described, but I have found several other forms that apparently must be classed under this genus. Figs. 138 and 139 represent two of these forms. Fig. 141 is perhaps a small specimen of *Ch. teres.* Fig. 142 represents a very common animal whose relations have appeared doubtful to me. I place them in this genus provisionally, although they may be young forms of some other genus.

Enchelys Ehrbg.

Differing from *Holophyra* chiefly in having an obliquely truncated neck-like prolongation with the mouth slightly on one side. No pharynx, a terminal anus, and a uniform ciliation. Nucleus spherical to ellipsoidal.

Enchelys is another genus that presents great difficulty in specific determination, and is frequently hardly distinguishable from *Holophyra.* Fig. 128 I regard as, perhaps, *En. pupa,* Ehrbg., while Figs. 124, 125, 126, and 134 are, with hesitation, placed in this genus, the evident lateral mouth apparently excluding them from *Holophyra.* More study is required before the limits of these two genera can be drawn.

Spathidium Duj.

Elongated, sac-shaped, flexible, with anterior end narrowed and flattened into a neck which is obliquely truncate. The mouth occupies the whole of the oblique surface and is usually surrounded by lips and closed. Pharynx sometimes with rods. Uniform ciliation, terminal vacuole, nucleus elongated and bead-like.

Spathidium is difficult to distinguish from *Enchelys.* Fig. 128, which I have called *Enchelys,* shows such an elongated neck as to suggest that it may be classed with *Spathidium.* Figs. 129 and 131 are clearly the latter genus.

S. sp. (?), Fig. 129.

S. spathula (?) Duj., Fig. 131.

Prorodon Ehrbg.

Ellipsoidal to ovate, with rounded ends, and occasionally somewhat flattened. The terminal mouth leads into a short or a long pharynx which is covered with a rod-like or a smooth membrane. Anus terminal; one or more contractile vacuoles; nucleus ovate to ribbon-like. Longitudinal striations; uniform ciliation, except that frequently there is a tuft of longer posterior cilia.

Pr. niveus Ehrbg., Fig. 136.

Pr. armatus C. & L., Figs. 137 and 137*a*.

Pr. griseus C. & L., Fig. 144.

The genus *Prorodon* presents wide variations in shape and size. Figs. 136 and 137 represent two extreme types that I have associated with specific names as above shown. Many intermediate forms between these are found.

Trachelophyllum Cl. & L.

Body much flattened, appearing flask-shaped upon the broad side, with an elongated neck-like anterior end. A small retractile proboscis in front, upon which is the mouth leading into a pharynx extending through the neck. Ciliation uniform, with longer cilia around the mouth. Contractile vacuole terminal and many nuclei.

Fig. 156 represents a very large infusorian that does not seem to agree exactly with any described genus. It differs from *Trachelophyllum* in not showing the proboscis, and in having the vacuole divided into many parts. For similar reasons it cannot be placed with *Lacrymaria,* while the other flattened infusorian, *Trachelocera,* is described as being only marine. I therefore place it provisionally with this genus.

Lacrymaria Ehrbg.

Form flask-shaped but changeable; with a short or a long, highly contractile neck, and a rounded posterior end; not flattened; with a plug-like projection carrying the mouth, which is surrounded with a crown of long cilia. Pharynx, a long or short tube frequently longitudinally striped. Body striped longitudinally or spirally; anus terminal or sub-terminal.

L. olor Müll., Fig. 149. Fig 149*a* is the same animal with its neck contracted.

L. sp. (?), Fig. 150, appears to be an undescribed form.

Trachelius Shrank.

Spherical to elliptical; the anterior end with a dorsally projecting proboscis, at whose base is the closed mouth, which leads into an armed pharynx. Contractile vacuoles numerous; nucleus central and commonly single. Ciliation uniform.

Tr. sp. (?). The animal shown in Fig. 148 does not agree with any described form, but it comes nearest to this genus.

Dileptus Duj.

Elongated, slightly compressed, with a long proboscis. Mouth at base of proboscis; pharynx short. Upon the ventral side of the proboscis a row of large cilia extending around the open mouth. Numerous contractile vacuoles along the back. Nucleus ribbon form to bead-like. Striation and ciliation uniform.

D. monilatus Stokes, Fig. 157.

D. gigas C. & L., Fig. 158.

D. sp. (?), Fig. 160.

Loxophyllum Duj.

Flat, leaf-like, with broad hyaline border (sometimes wanting on the left side). Proboscis only slightly developed; mouth on the left, commonly closed. Trichocysts on the right border either scattered or in papilla-like groups. Contractile vacuole posterior, nucleus ribbon or bead-like. Longitudinally striate.

Lox. rostratum Cohn, Fig. 161.

Lox. sp. (?), Fig. 162.

Lox. lamella Ehrbg., Fig. 163.

Lox. sp. (?), Fig. 165.

Amphileptus Ehrbg.

Body elongated, somewhat flattened, prolonged in front into an acute proboscis at whose base lies the mouth, which is commonly closed and not visible. Numerous contractile vacuoles scattered over the surface, or a single terminal vacuole. Nucleus single or double.

Am. gutta Clap., Fig. 143.

Am. sp. (?), Fig. 145.

Nassula Ehrbg.

Ovate to cylindrical; rounded posteriorly. Mouth ventral, about one-third of the way from the anterior end. On the left side, at the top of the mouth, is a depression. From the mouth, extending forward to the left, is a zone of stronger cilia. Pharynx armed with rods straight or curved. Anus terminal. The animals usually contain yellowish, brownish or violet drops, which are derived from the *Oscillaria* which serve as their food.

N. ornata Ehrbg., Fig. 169. Fig. 170 shows the animal in the art of feeding upon a long filiamentous alga.

N. sp. (?), Fig. 164. A much smaller type with more evident trichocysts.

Ophryoglena Ehrbg.

Ellipsoidal, with the posterior end somewhat acute. Ciliation and striation regular. Mouth a third of the distance behind the anterior end, commonly closed, a crescent-shaped or spiral slit, surrounded by a lip and leading into a short pharynx. Upon the left of the mouth is a black homogeneous watch glass-shaped body. One or more contractile vacuoles with well developed vessels. Nucleus single, ellipsoidal or ribbon-shaped, and a spindle-shaped secondary nucleus.

Op. sp. (?), Fig. 221. The placing of this animal in this genus is tentative.

Frontonia Ehrbg.

Ellipsoidal to elongated, somewhat acute behind. Mouth not far from the anterior end, surrounded by elevated ridges which extend backward and gradually vanish. Pharynx short, with rods and two undulating membranes, the left one serving as a grasping organ. Ciliation and striation regular. Nucleus ellipsoidal. One or more secondary nuclei and usually one contractile vacuole. Trichocysts present except in the groove extending from the mouth.

Fr. sp. (?), Fig. 185. This is the largest holotrichous infusorian I have seen, reaching a length of 400-500 μ. It is found somewhat abundantly in New Haven and Middletown.

Fr. sp. (?), Fig. 186. Our most common species.

Fr. sp. (?), Fig. 198. This is a new type of *Frontonia,* with a body very much flattened, its dorso-ventral diameter being less than one-third of its lateral diameter. It is abundant in our waters.

Colpoda Müll.

Laterally compressed, with the dorsal surface rounded and the ventral surface straight. Mouth on the ventral surface one-third of the distance back of the anterior end. Upon the posterior edge of the mouth is a number of long cilia. Multiplication by division into four or more parts in an encysted condition.

There is a large number of species of this genus found in our waters. Stokes has described many of them. He divides the genus into two, one of which he names *Tillina;* but this division is not generally accepted. The species described by Stokes that I have found, up to the present time, are in the following list:

C. sp. (?), Fig. 187.
C. campyla, Fig. 188.
C. saprophila, Figs. 189 and 190.
C. sp. (?), Fig. 191.
C. inflata, Fig. 192.
C. sp. (?), Fig. 193.
C. gigas, Figs. 195 and 205.
C. cucullus O. F. Müll., Fig. 196.

Paramecium Müll.

Elongated, slightly flattened. Rounded at both ends or obliquely truncated in front. Mouth in the middle of the ventral surface or further back, in the bottom of a three-cornered peristome depression, extending toward the left side. Anus ventral between the mouth and the end, or terminal. Ciliation regular; nucleus ellipsoidal, central; secondary nuclei, close by, short and spindle-formed. Numerous trichocysts.

Par. caudatum Ehrbg., Fig. 203.
Par. bursaria Ehrbg., Figs. 201 and 202.
Par. trichium Stokes, Fig. 206.

Colpidium Stein.

Similar to *Colpoda,* but less compressed, and with an undulating membrane in front. Mouth oblique, three-cornered. A small peristome a third of the distance from the front. Pharynx short; nucleus spherical, central. Contractile vacuole posterior and dorsal.

C. striatum Stokes, Fig. 176 and Fig. 177.

C. sp. (?), Fig. 183. Referred with doubt to this genus.

C. sp. (?), Fig. 194. A very large form, larger than any described species of *Colpidium.* It may not belong to this genus; but at present I am unable to locate it elsewhere. It is a moderately abundant animal.

Glaucoma Ehrbg.

Somewhat ovate, flattened. Mouth a quarter of the distance from the anterior end, a little to the right; triangular to crescent-shaped, with two undulating membranes. Striation and ciliation regular. Nucleus spherical, central, and a secondary nucleus.

Gl. scintillans Ehrbg., Fig. 182.

Gl. scintillans (?) Ehrbg., Fig. 171.

Fig. 207 represents a common minute infusorian that appears to be *Trichoda pura* (Ehrbg.), which Bütschli places with *Glaucoma.* I can detect no membranes in our specimens, and prefer to retain the name *Trichoda.*

Dallasia Stokes.

Elongated, rounded in front and contracting into a tail behind. One side somewhat flattened, the other convex. Mouth near the front and somewhat triangular, with two membranes much like those of *Glaucoma.* Contractile vacuole single; nucleus single and central.

D. frontonia Stokes, Fig. 175. In the specimens found here the vacuole is posterior instead of anterior as described by Stokes.

Uronema Duj.

Ovate, acute, anteriorly compressed, with the ventral surface straight and the dorsal curved. Mouth in the middle of the ventral surface or somewhat more forward, surrounded by one or more undulating membranes. From the mouth forward extends a furrow in which the

cilia are densely arranged. Pharynx wanting; striation and ciliation regular. On the posterior end a bristle.

U. marinum (?) Duj., Fig. 181, two varieties.

Dexiotricha Stokes.

Similar to the above, but with a spiral row of cilia.

D. plagia Stokes, Fig. 197.

Cinetochilum Perty.

Rigid, flattened, oval, with deeply spiral furrows. Upon the ventral side, beginning at the posterior end, is a peristome slightly widening in front, where the mouth is found, surrounded by an undulating membrane. Ciliation uniform. At the posterior end, upon the right and left, a few long, thread-like cilia. Contractile vacuole posterior, upon the right.

C. margareticum Ehrbg., Fig. 199, ventral and lateral views.

Microthorax Engelm.

Small, nearly oval, the left side straight and the right curved. Ventral surface flat, with two furrows parallel to the right side; dorsal edge curved. Mouth in a flat peristome, posterior, upon the left side, with an undulating membrane on the right. Cilia few, uniform. Nucleus central; contractile vacuole in front of the mouth.

M. sulcatus (?) Ehrbg., Fig. 200, is our common form, but it appears to be smaller than the species *sulcatus*.

Lembadion Perty.

Rigid; oval when seen from the back. Posterior end somewhat acute, anterior end oblique. Ventral surface flat, dorsal convex. A large peristome, which almost covers the whole of the right side of the body, and which carries on its left side an undulating membrane, almost filling the peristome. Striation longitudinal; ciliation uniform, but with a tuft of posterior, longer cilia. Nucleus short, cord-like. One contractile vacuole.

L. bullinum Perty, Fig. 204.

Pleuronema. Duj.

Somewhat oval and flattened dorso-ventrally; both ends rounded; left side more curved than right side. Upon the right side of ventral surface is a large, furrow-

like peristome, from which protrudes a large undulating membrane. Cilia long; striation regular; nucleus spherical, and contractile vacuole terminal. Trichocysts sometimes present.

Cyclidium Ehrbg.

Very similar to *Pleuronema* and frequently united with it. Differs in being smaller, having a shorter peristome and one or more long bristles at posterior end.

Figs. 208 *a, b,* and *c,* represent three types of *Cyclidium,* perhaps *Cy. glaucoma.* Fig. 209 is Stokes' species, *Cy. limetosum.* Figs. 211 to 215 are undetermined species, apparently referable to the genus *Pleuronema.*

Mesodinium Stein.

Small, pear-shaped, with a furrow in the middle; anterior end conical; the mouth at anterior end leads into a long pharynx. Posterior end spherical. In the furrow is a crown of strong cilia, which is occasionally wanting. Four small knob tentacles around the mouth. Nucleus spherical to kidney-shaped, central. Anus and contractile vacuole terminal.

M. sp. (?), Fig. 135. In this specimen the knobs were not seen.

Urocentrum Nitzsch.

Somewhat cylindrical, with a constriction slightly behind the middle. Mouth posterior, surrounded by a flattened area, with a furrow extending backwards; a row of closely arranged cilia, extending as a girdle around the body. A short pharynx. The anterior part of the body uniformly ciliated, with a broad zone of cilia near the middle and posterior end. A prominent tuft of fused cilia at posterior extremity. Nucleus worm-shaped, in the hinder part of the body, with round, secondary nuclei. Anus and contractile vacuole terminal.

Ur. turbo Müll., Fig. 210.

Lionotus Wrz.

Elongated, with a flattened, ciliated, ventral (right side) surface, and a convex, dorsal (left side) surface; commonly with an evident proboscis, which is hyaline, as is also the short caudal extremity. On the left side of pro-

boscis a row of long cilia with trichocysts. Mouth a long slit, upon left side at base of proboscis, commonly not visible. Usually two nuclei and a contractile vacuole at beginning of the tail, near the dorsally opening anus.

L. wrzesniowskii Kent, Fig. 155.

L. sp. (?), Fig. 146.

L. fasciola Ehrbg., Fig. 147.

Fig. 133 represents a form which I have provisionally placed with this genus.

New Genus (?).

Body elongated and uniformly ciliate, with a proboscis resembling *Lionotus*. The mouth, however, is terminal, and leads into a pharynx armed with rods. Nucleus double, and several contractile vacuoles.

Fig. 159. Only a single specimen of this peculiar form has been found.

Loxodes Ehrbg.

Inflexible, flattened, elongated, and leaf-like, the anterior end hook-like and bent to left. Ventral surface flat, with ciliated ribs, dorsal surface smooth, curved, and without cilia. The edge of the body with somewhat longer cilia. Mouth on the left anterior edge, at the bottom of a slit-like peristome and leading into an evident pharynx. Many nuclei and secondary nuclei. Contractile vacuoles uncertain.

Lox. rostrum Müll., Fig. 154.

Chilodon Ehrbg.

Much compressed, with a flat or slightly hollowed ventral surface, and a convex dorsal surface. A thin, flexible hyaline border prolonged in front into a projection directed forward and to the left. Mouth in the middle of the body, with a basket-like pharynx of ten to sixteen rods; its inner end frequently spirally rolled. Ventral surface regularly striated and ciliated. Dorsal surface without cilia. A band of stronger cilia extending from the mouth to the end of the elongated projection. Nucleus ellipsoidal, of peculiar structure. One or more contractile vacuoles.

Ch. cucullulus Müll., Fig. 174.

Ch. vorax Stokes, Fig. 180.

Ch. caudatus Stokes, Figs. 166 and 173.†

Ch. megalotrocha Stokes, Fig. 168. An extremely common species in infusions.

Ch. sp. (?), Fig. 172.

New Genus (?).

Body nearly spherical in outline, with a slight lip at anterior end, at bottom of which is found a mouth. Six prominent rows of cilia on ventral surface, extending from pole to pole. Nucleus and contractile vacuole present, posterior. Motions slow. No evident pharynx.

Fig. 184. This peculiar animal has been found several times in our water. It cannot be placed in any genus known to me.

ORDER HETEROTRICHA.

Key to Genera.

1. With undulating membrane..... 2
   Without undulating membrane..... 3
2. Flattened; narrowed in front, peristome long, on left *Blepharisma**
   Cylindrical or purse-shaped; not flattened; peristome short, inclosing the wide anterior end..*Condylostoma**
   Body more or less spiral; peristome furrow-shaped.. *Metopus**
3. Membranellæ evident and somewhat spiral..... 4
   Membranellæ not spiral, feather-like; body in a lorica 5
4. Long, thread-shaped, or somewhat flattened..... *Spirostomum**
   Purse-shaped; oblique in front, peristome funnel-shaped, sunken in the body.....*Bursaria**
   Purse-shaped; peristome flat, inclosing whole anterior end of body.....*Climacostomum*
   Purse-shaped; peristome broad in front but not inclosing whole anterior end of the body, extending obliquely to the right.....*Balantidium*

† This is *Chilodon caudatus* of Stokes, but should perhaps more properly be placed under the generic name *Ægyria* because of its caudal appendage. *Ægyria* is said to contain one species only and to be found only in salt water, and that species is certainly not the one described above.

Body funnel-shaped to ovate, peristome inclosing anterior end and surrounded by ciliated zone...*Stentor**

5. Lorica tubular, gelatinous.....*Tintinnidium*
Lorica various, chitinous.....*Tintinnus*

Description of Genera.

Blepharisma Perty.

Much flattened; anterior end acute, somewhat hook-like, and bent to the left. Peristome a deep furrow close to the left-hand border in front, and extending to the middle of the body, where is found a short, slightly bent pharynx. On left wall of peristome is a row of strong membranellæ, but upon its right side an undulating membrane. Body spirally striate.

Bl. sp. (?), Fig. 216.
Bl. undulans (?), Fig. 217.
Bl. ovata (*Apgaria* of Stokes), Fig. 218.
Bl. sp. (?), Fig. 228.

Condylostoma Duj.

Sometimes contractile, sometimes not, with a body either elongated or rounded. Peristome extending one-third of the distance behind the anterior end. Mouth broad, pharynx slightly developed. An evident undulating membrane on right side of peristome. Nucleus bead-like on the right side. Contractile vacuole and anus terminal.

Con. sp. (?), Fig. 220. The identification of this animal is doubtful.

Metopus Cl. & L.

Cylindrical, somewhat acute at both ends. Peristome a long furrow extending from the left anterior end, in a spiral direction, to the mouth, which lies near the middle of the ventral side. Pharynx short. Anterior end of body bent toward the ventral surface and toward the left so that the anterior portion of the peristome is covered. On left side of peristome is a row of membranellæ. On right side an undulating membrane. Striations regular; ciliation uniform, but with a tuft of longer cilia on the anterior and posterior ends. Nucleus cylindrical, with a

secondary nucleus. Anus and contractile vacuole terminal. Body very contractile, assuming a variety of forms, as shown in Figs. 223, 224, and 225, which may, however, be regarded as separate species.

M. sigmoides Cl. & L., Figs. 223-225.

Spirostomum Ehrbg.

Very contractile, elongated, cylindrical or thread-formed. Peristome a long furrow reaching to the middle of the body and leading into a short pharynx. Strong membranellæ on the left side of the peristome, but no undulating membrane. Striation spiral. Nucleus ellipsoidal or bead-like. Anus terminal; a contractile vacuole extending almost to the anterior end.

Sp. teres Cl. & L., Fig. 222.

Sp. ambiguum Ehrbg., has also been found, but no figure of it is given.

Bursaria O. F. Müll.

Inflexible, somewhat purse-shaped. In front obliquely truncate. Behind broadly rounded. Ventral surface flat. Dorsal surface convex. Peristome extending from the anterior backwards into a deep funnel, which opens on the ventral side by a slit reaching as far as the middle of the body, and passing imperceptibly into a pharynx-like tube. Adoral zone on the left side of the peristome composed of small membranellæ. Striations regular; nucleus long and ribbon-like and many secondary nuclei. Many small contractile vacuoles and a terminal anus.

B. truncatella Müll, Fig. 231.

Stentor Ehrbg.

Fixed, or free swimming. When attached the body is elongated and trumpet-formed, with a more slender posterior end, sometimes inclosed in a jelly-like lorica. When free swimming, pear-shaped to ovate. A spiral row of strong cilia extending around the truncated anterior end, beginning on the ventral side with an inwardly projecting curve, and extending from there over the right dorsal and left side again to the ventral side, where it ends in a mouth leading into a short pharynx. Striations evident; ciliation fine and regular; nucleus ellipsoidal, thread-formed or

bead-like. Many small secondary nuclei. Anus near the left end of the adoral spiral. The contractile vacuole, lying in the same region, has a long canal reaching to the posterior end of the body.

S. cæruleus (?) Ehrbg., Fig. 240.

S. polymorphus Ehrbg., Fig. 246. Fig. 245 represents the same species, possibly. The species is highly variable. Fig. 245 shows the animal in process of division.

Balantidium Cl.' & L.

This is a parasitic genus. Fig 219 found free swimming is provisionally referred to this genus. Possibly *Bal. coli.*

ORDER HYPOTRICHA.

Key to Genera.

1. Body flattened..... 2
   Body not flattened..... 13
2. Cilia bristle-like, in groups..... 3
   Ventral side uniformly ciliate except sternum; a group of stronger cilia behind peristome and near posterior end.....*Trichogaster*
3. Many border cilia..... 4
   Few or no border cilia..... 12
4. Ventral cilia many, in rows..... 5
   Ventral cilia few, rows not evident..... 10
5. Ventral cilia all bristle-like, two or more rows..... 6
   Ventral cilia style-like, sometimes with two additional rows of cilia parallel to right border, or with three such rows of which the inner has only a few cilia..... 9
6. Five or more longitudinal rows of ventral cilia; peristome on ventral surface.....*Urostyla**
   Five nearly straight rows of ventral cilia; peristome lateral .....*New genus**
   Six oblique rows of ventral cilia; body kidney-shaped *Kerona*
   Two or three rows of oblique cilia; body elongated in front into a neck.....*Stichotricha**
   Two rows of ventral cilia; body not elongated in front 7

One row of about seven large ventral cilia; no sternal cilia and with long border and anal cilia.... *Belladina*

7. Body flask-shaped..... *Platytrichotus**
Body not flask-shaped..... 8

8. With no sternal cilia..... *Holosticha**
With five sternal cilia and fifteen to seventeen anal cilia upon the left side..... *Amphisia*
With three sternal and no anal cilia; body narrowed behind ..... *Uroleptus**
With the two rows of ventral cilia wide apart, and no sternal cilia..... *Psilotricha*

9. Five ventral cilia and two or three rows of bristle-like cilia on either side, of which the inner rows have only a few cilia..... *Pleurotricha**
Three of four oblique rows of cilia, and three rows parallel to the peristome border..... *Onychodromus**
One somewhat irregular oblique row of bristle-like cilia and five or six sternal cilia..... *Gastrostyla*

10. Peristome wholly lateral, very small; usually two ventral cilia in front and five anal cilia.. *Gonostonum*
Eight ventral cilia and five anal cilia at the base of the tail..... *Urosoma**
Five ventral cilia..... 11

11. Inner wall of peristome bent toward outer wall; without caudal bristles; body usually flexible.... *Oxytricha**
Inner wall of peristome bent toward the outer wall; without caudal bristles; body not flexible.... *Histrio**
Inner wall of peristome bent away from outer wall; usually with three caudal bristles..... *Stylonychia**

12. Four border cilia at posterior end; adoral zone surrounding the front..... *Aspidisca**
No border cilia; adoral zone confined to the left side *Euplotes**

13. Bearing outside the adoral zone, near the middle, a simple or double crown of long bristles..... *Halteria**
Like the above but without the crown of bristles.... *Strombidium**

Urostyla Ehrbg.

Elliptical to ovate, both ends rounded. Ventral surface flat, dorsal surface curved; body flexible. Three or more bristle-like sternal cilia and five or more longitudinal rows of ventral cilia, those on the sternum especially developed, while those on the rest of the body are smaller. Commonly five to twelve anal cilia in an oblique row, extending to the left. Peristome an elongated triangle with an undulating membrane. Two or more nuclei.

U. trichota (*Hemiclostyla* of Stokes), Fig. 237.

U. vernalis (?) Stokes, Fig. 239.

U. trichogastra Stokes, Fig. 241. Perhaps all of these are only varieties of *U. grandis* Ehrbg.

New Genus

Elongate, rounded at both extremities, not flexible. Peristome on the right hand margin and extending back of the middle, marked by a row of long cilia or membranellæ, that bends to the left to lead to the mouth. Besides border cilia there are four oblique rows of cilia upon the ventral surface. Nuclei, four in number; contratile vacuole single.

The interesting animal shown in Fig. 279 does not agree with any described genus. Two specimens have been found.

Stichotricha Perty.

Elongated, narrowed in front, rounded behind, with a body nearly cylindrical and very contractile. Peristome narrow, upon the left side, extending to the middle or even back of it. Membranellæ long, the two or three anterior ones extending over the front end of the body as bristles. The border cilia extend uninterruptedly around the posterior end. Sternal and anal cilia wanting.

St. secunda Perty, Fig. 236.

Uroleptus Ehrbg.

Sometimes contractile, sometimes not; elongated, narrow, cylindrical or flattened. Anterior end rounded, posterior end prolonged into a caudal projection. Three sternal cilia, two rows of ventral cilia, but no anal cilia. The border cilia pushed on to the ventral surface. Peristome about one-third the length of the body.

U. longicaudatus Stokes, Fig. 232.
U. musculus Ehrbg., Fig. 233.
U. musculus (?), Fig. 234.
U. dispar Stokes, Fig. 243.

Platytrichotus Stokes.

Like *Uroleptus,* but body flask-shaped. Frontal styles five; two rows of ventral cilia, and no anal cilia. Border cilia uninterrupted.

Pl. opisthobolus Stokes, Fig. 238.

Pleurotricha Stein.

Not contractile, rounded at both ends; somewhat oval in outline, with eight sternal cilia. Ventral cilia arranged in two rows; five anal cilia, of which the two on the right side are near the end of the body. Border cilia an unbroken row. Between the border cilia and the ventral cilia, upon one or both sides, are one to three accessory rows of bristle-like cilia. Upper lip developed; peristome broad, one-third the length of the body.

Pl. sp. (?), Fig. 235.

Onychodromus Stein.

Not flexible. In outline somewhat rectangular, with slightly rounded ends. Ventral surface flat, dorsal surface convex. Peristome broad, three-angled, reaching to the middle of the body. Upper lip present. On the right anterior end three strong cilia behind which are three rows of cilia parallel with the right edge of the peristome. Three or four oblique rows of ventral cilia, running from right to left; five or six strong anal cilia; border cilia uninterrupted. Upon the dorsal surface two processes. Four to eight nuclei and one contractile vacuole.

On. grandis Stein, Fig. 247.

Urosoma Kow.

Similar to *Oxytricha,* but with eight ventral cilia. Posterior extremity prolonged, with five to eight cilia at the beginning of the prolongation.

U. cienkowski Kow., Fig. 248. This is provisionally referred to this genus. Only one specimen yet found.

Oxytricha Ehrbg. (Stein, Sterki).

Narrow elliptical, rounded at both ends. Ventral sur-

face flat, dorsal surface convex; flexible. Right border of the peristome bending toward the left. Eight sternal cilia; five ventral and five anal cilia. Without caudal appendages; border cilia often crowded on to the ventral surface.

Ox. pellionella Müll., Fig. 249.
Ox. bifaria Stokes, Figs. 250, 256, and 257.
Ox. fallax Stein, Fig. 251.
Ox. parvistyla Stein, Figs. 252 and 253.
Ox. hymenostoma Stokes, Fig. 254.
Ox. sp. (?), Fig. 255.
Ox. agilis Stokes, Fig. 260.
Ox. sp. (?), Fig. 261.

Holosticha Wrz.

This genus is frequently united with *Oxytricha,* but is here separated by the absence of the regular eight sternal cilia and the presence of two uninterrupted rows of ventral cilia.

H. sp. (?), Fig. 242.
H. vernalis Stokes, Fig. 244.
H. setigera (?), Fig. 265.

Histrio Sterki.

Inflexible, similar to *Stylonychia,* but with a narrower peristome, which has its right border turning somewhat toward the left. The caudal bristles are wanting.

H. sp. (?), Fig. 262.
H. crethisticus Stokes, Fig. 263.
H. complanatus Stokes, Fig. 264.

Stylonychia Ehrbg.

Inflexible, rarely flexible, with flat ventral and convex dorsal surface. Peristome broadly three-angled, reaching to the middle of the body, or shorter; its right border not bent toward the left. Eight sternal, five ventral and five anal cilia arranged as in *Oxytricha.* The middle of the three sternal cilia is immediately behind the right edge of the upper lip. Commonly three large caudal bristles interrupting the border cilia.

St. pustulata Ehrbg., Fig. 258. Not exactly like the described species. Fig. 266.

St. notophora Stokes, Fig. 259.
St. sp. (?), Fig. 267. Perhaps a variety of *St. mytilis.*
St. putrina Stokes, Fig. 269.
St. mytilus Müll., Fig. 273.
St. fissieta C. & L., Fig. 282.

Euplotes Ehrbg. (Stein).

Armored, inflexible, round to oval outline, with ventral surface flat, and dorsal surface convex; ribbed. Peristome large, broad, three-angled, reaching the middle of the body or still further back. The right edge of the peristome slightly drawn out to partly cover the peristome. Nine or ten large cilia upon the sternum; five large anal cilia and four border cilia, two of which are usually at the hind end and two at the posterior left lateral border. Nucleus ribbon-like on the left side, bending in front and behind toward the right. Secondary nuclei near the left front end of the nucleus. Contractile vacuole on the right border.

Eu. sp. (?), Fig. 268.
Eu. carinata Stokes, Fig. 270.
Eu. plumipes Stokes, Fig. 271.
Eu. charon Müll., Fig. 272.

Aspidisca Ehrbg.

Inflexible, round or short oval in outline. Left side slightly and right side strongly curved; ventral side flat, dorsal side convex. Right border thickened. Adoral zone not extending around the anterior end, but reaching backward beyond the middle of the body. The right border of the peristome extends over the peristome so that it is open only by a narrow opening on the left side. Anterior border with a bay-like depression, or sometimes drawn out into a hook-like process. Hind end of the peristome border with one or more teeth from which a transverse channel extends over the ventral surface in front of the anus. Seven scattered ventral cilia, and commonly five anal cilia. Nucleus thread-like, sometimes describing a complete circle. Contractile vacuole simple.

Asp. costata Duj., Fig. 281.
Asp. sp. (?), Fig. 280.

Halteria Duj.

Inflexible, spherical. Upon the anterior end an adoral ciliated zone which extends from the right over the dorsal surface to the left, and then leads to a ventral mouth. The part of the body surrounded by the spiral zone slightly protruding. Near the middle of the body is a crown of simple long bristles, but otherwise it is without body cilia. Spherical nucleus; contractile vacuole near the left side.

H. grandinella Müll., Fig. 227. Fig. 227*a* shows the same species in process of division. Another view of probably the same animal is shown in Fig. 230.

Strombidium Cl. & L.

Like *Halteria,* but without the bristles. The part of the body surrounded by the ciliated zone is protrusible; frequently with trichocysts. Upon the ventral surface a few single cilia or groups of cilia; colorless or yellowish; nucleus and contractile vacuole as in *Halteria.*

Str. sp. (?), Fig. 229.

ORDER PERITRICHA.

Key to Genera.

1. No lorica..... 2
   With lorica 8
2. No stalk..... 3
   With stalk; simple or branched, with or without an axial fibre..... 5
3. Posterior ciliated ring persistent; the disk-shaped posterior end with a chitinous ring.....*Trichodina**
   Posterior ciliated ring found only in the swimming stage 4
   Posterior ciliated ring wholly absent; never attached; posterior end with two bristles....*Astylozoön*
4. Posterior end elongated; usually attached.....*Scyphidia*
   Posterior end not elongated; body conical; attached or free; when contracted acorn-shaped.....*Gerda*
5. Stalk branched..... 6
   Stalk simple..... 7
6. Stalk retractile; each zooid contracting separately.. *Carchesium**

Stalk retractile; all zooids contracting together.... *Zoöthamnium**
Stalk not retractile; peristomial disk broad....*Epistylis**
Stalk not retractile; peristomial disk long-stalked.. *Opercularia**
7. Stalk retractile.....*Vorticella**
Stalk not retractile; without an operculum..*Rhabdostyla**
Stalk not retractile; with operculum.....*Pyxidium**
8. Lorica gelatinous .....*Ophrydium*
Lorica chitinous 9
9. Cylindrical to ovate, unstalked or with a short cylindrical stalk .....*Cothurnia*
Ovate, cup-shaped or flattened, with an ear-shaped projection bearing the mouth; a short, thick ringed stalk .....*Cothurniopsis*
Flattened, with the whole of one side attached to the support; animal attached to the lorica by a stalk-like outgrowth .....*Vaginicola*
Flattened, with posterior flattened end attached to the support; with the peristome process attached to the edge of the mouth.....*Lagenophrys*

Description of Genera.

Trichodina Ehrbg.

Solitary, short, cylindrical or barrel-form, with a posterior row of cilia, over which lies a ring-like fold running around the body. The circular flat base with which the animal attaches itself forms a sucker. It is covered by a chitinous membrane whose peripheral zone is radially striated. Adoral zone extends spirally around the flattened anterior end. Nucleus ribbon-shaped and one contractile vacuole. Animals all parasitic.

P. pediculus Ehrbg., Fig. 301. On *Hydra.*

Vorticella Linn.

Body bell-formed, with a more or less evident, outwardly extending peristome; cuticle often ringed. With a contractile stalk, frequently longer than the body, by which the animal is attached. Adoral zone describing more than a circle. Nucleus simple, ribbon or horse-shoe

shape. Secondary nucleus near the primary nucleus. One contractile vacuole. The animals frequently live in companies but are never colonial.

Figs. 274-277, 283-286, 291-294, 296 and 298 represent a number of separate types of *Vorticella* found in our waters. It is difficult to arrange them satisfactorily into species, and no attempt will be made in the present paper to attach specific names to the forms described.

Rhabdostyla S. K.

Solitary, upon a short, not contractile stalk. In other respects like *Epistylis.*

R. brevipes Cl. & L., Fig. 278.

R. sp. (?), Fig. 295.

Pyxidium S. K.

Solitary, with a short stalk; in other respects agreeing with *Opercularia.*

P. ramosa Stokes, Fig. 290.

Epistylis Ehrbg.

Colonial, the single individuals of the colony standing about the same height. With a stiff branched stalk containing a canal, but no muscles; hence, not contractile. Animals narrow to broad bell form, mostly with a ringed cuticle.

E. flavicans Ehrbg., Figs. 287, 288, 289. The last figure shows that the spiral band makes four circles around the disk.

Carchesium Ehrbg.

Forming richly branched colonies in which the stalk muscles of the single individual are not attached, but end abruptly at the base of the individual stalks, enabling the individuals to contract independently. Animals all alike in size and structure. Ciliated spiral forming about one and a half circles. Nucleus horse-shoe shape, with a small secondary nucleus near by. One contractile vacuole.

C. polypinum Linn., Fig. 299.

Zoöthamnium Ehrbg.

Much like *Carchesium,* but with a common muscle in the stalk, causing all individuals of the colony to contract together.

One species of *Zoöthamnium* has been found, but no figure of it has yet been made.

Opercularia Stein.

Colonial, with stiff branched stalks which are often ringed. Animals not bell-shaped, but ellipsoidal to ovate, with a peristome not expanded. The ciliary disk upon a long, thin stalk, around which a vestibule extends on either side, closing like a lid. Nucleus short or ribbon-like. One contractile vacuole.

Op. sp. (?), Fig. 297 *a, b, c.*

CLASS SUCTORIA.

Key to Genera.

1. Tentacles simple 2
   Tentacles branched; not retractile ..... *Dendrocometes*
2. No shell 3
   With shell 6
3. No stalk 4
   Stalked, tentacles on all sides or in bundles .. *Podophrya**
4. Solitary 5
   Colonial, base branched with branching offsets whose swollen ends constitute the individuals ... *Dendrosoma*
5. Spherical; tentacles on all sides ..... *Sphærophrya**
   Irregular, fixed by a broad base; tentacles in bundles *Trichophrya*
   With a single movable anterior process instead of tentacles; parasitic on *Cyclops* ..... *Rhyncheta*
6. Shell unstalked, posterior end prolonged into a projection; attached to *Epistylis;* two to five long movable tentacles ..... *Urnula*
   Unstalked; disk-formed, tentacles in bundles ..... *Solenophrya*
   Stalked, frequently enclosed by lobes in front .... *Acineta*

Description of Genera.

Sphærophrya Cl. & L.

Without stalk; somewhat spherical, covered with knobbed tentacles. Nucleus round or ellopsoidal. One contractile vacuole.

S. magna Maup., Fig. 303.

Podophrya Ehrbg.

Spherical to pear or club-shaped, upon a stalk. Tentacles usually knobbed, either in groups or scattered over the surface. Nucleus simple with a secondary nucleus. One or more contractile vacuoles. In some species the animals may become detached from the stalk and live in a free condition.

P. sp. (?), Figs. 300, 302.

Index.

Acanthocystis, 17.
Acineta, 65.
Actinobolus, 40.
Actinophrys, 17, 18.
Actinosphærium, 17.
Ægyria, 42.
Amœba, 12, 14.
Amphidinium, 39.
Amphileptus, 41, 46.
Amphimonas, 32, 34.
Amphisia, 57.
Amphitrema, 14.
Amphizonella, 12.
Anisonema, 30, 31.
Anoplophrya, 40, 43.
Anthophysa, 21, 23.
Arcella, 12, 15.
Ascoglena, 25.
Aspidisca, 57, 61.
Assulina, 13.
Astasia, 26, 29.
Astasiopsis, 25.
Astylozoön, 62.
Atractonema, 25.
Balantidium, 53, 56.
Belladina, 57.
Bicoscœca, 20.
Blepharisma, 53, 54.
Bodo, 30.
Bursaria, 53, 55.
Calyptotricha, 42.
Campascus, 13.
Carchesium, 62, 64.
Carteria, 33.
Centropyxis, 12, 15.
Cephalothamnium, 21, 23.
Ceratium, 39.
Cercobodo, 20, 21.
Cercomonas, 20, 22.
Chænia, 40, 43.
Chilodon, 42, 52.
Chilomonas, 32, 35.
Chlamydomonas, 33, 37.
Chlorangium, 33, 37.
Chlorogonium, 33.
Chloropeltis, 25, 28.
Choanoflagellata, 19, 38.
Chromulina, 24.
Chrysopyxis, 33.
Ciliata, 11, 39.
Ciliophrys, 20.
Cinetochilum, 41, 50.
Cladomonas, 34.
Clathrulina, 17, 18.
Climacostomum, 53.
Clostonema, 26, 29.
Coccomonas, 33.
Cochliopodium, 12.
Codonocladium, 38.
Codonœca, 20.
Codonosiga, 38.
Cœlomonas, 24.
Colacium, 25.
Coleps, 40, 42.
Collodictyon, 32.
Colpidium, 41, 49.
Colpoda, 41, 48.
Colponema, 30.
Conchopthirus, 41.
Condylostoma, 53, 54.
Cothurnia, 63.
Cothurniopsis, 63.
Cryptoglena, 24, 26.
Cryptomonas, 33, 36.
Cyathomonas, 32, 35.
Cyclidium, 42, 51.
Cyphoderia, 13.
Dactylosphærium, 12, 14.
Dallasia, 41, 49.
Dendrocometes, 65.
Dendromonas, 21.
Dendrosoma, 65.

Dexiotricha, 41, 50.
Diaphoropodon, 13.
Didinium, 42.
Difflugia, 12, 15.
Dileptus, 40, 46.
Dimorpha, 20.
Dinobryon, 21, 23.
Dinoflagellata, 19, 39.
Dinomonas, 29, 31.
Diplophrys, 14, 16.
Ditrema, 14.
Enchelys, 40, 44.
Elvirea, 29, 31.
Entosiphon, 30, 32.
Epipyxis, 21.
Epistylis, 63, 64.
Ervilia, 42.
Eudorina, 34.
Euglena, 25, 26.
Euglenoidina, 20, 24.
Euglypha, 13, 16.
Euplotes, 57, 61.
Eutreptia, 25, 27.
Flagellata, 19.
Frontonia, 41, 47.
Gastrostyla, 57.
Gerda, 62.
Glaucoma, 41, 49.
Glenodinium, 39.
Gloidium, 12.
Gonium, 34.
Gonostomum, 24, 57.
Gromia, 13.
Gymnodinium, 39.
Gymnophrys, 11.
Hæmotococcus, 33.
Halteria, 57, 62.
Heleopera, 13.
Heliozoa, 11, 17.
Hermidinium, 39.
Hermidium, 38.
Heteromastigoda, 19, 29.
Heteronema, 30, 32.
Heterophrys, 17.
Heterotricha, 39, 53.
Hexamitus, 33, 36.
Histrio, 57, 60.
Holophrya, 40, 43.
Holosticha, 57, 63.
Holotricha, 39.
Hyalodiscus, 12, 14.
Hyalosphenia, 12.
Hypotricha, 39, 56.
Isomastigoda, 20, 32.
Kerona, 56.
Lacrymaria, 40, 45.
Lagenophrys, 63.
Lecquereusia, 13, 15.
Lecythium, 13.
Lembadion, 42, 50.
Lepocinclis, 25, 27.
Leptomonas, 21, 23.
Leucophrys, 40.
Lieberkuhnia, 13.
Lionotus, 42, 51.
Loxodes, 42, 52.
Loxophyllum, 41, 46.
Mallomonas, 21, 24.
Maryna, 29.
Mastigamœba, 20, 21.
Mastigophora, 11, 19.
Menoidium, 25, 28.
Mesodinium, 42, 51.
Metanema, 30, 31.
Metopus, 53, 54.
Microcometes, 14.
Microglena, 24.
Microgromia, 14, 16.
Microthorax, 41, 50.
Monadina, 19, 20.
Monas, 21, 22.
Monobia, 17.
Monosiga, 38.
Nassula, 41, 47.
Nebela, 13.
Nephroselmis, 33.
New genera, 40, 42, 52, 53, 56, 58.
Notosolenus, 20, 22.
Nuclearia, 17, 18.
Ochromonas, 21, 33, 36.
Oikomonas, 20, 22.
Onychodromus, 57, 59.
Opercularia, 63, 65.
Ophrydium, 63.

Ophryoglena, 41, 47.
Opisthodon, 42.
Oxytricha, 57, 59.
Pamphagus, 13, 16.
Pandorina, 34, 37.
Paramecium, 41, 48.
Pelomyxa, 12, 14.
Peranema, 25, 28.
Peridinium, 39.
Peritricha, 39, 62.
Petalomonas, 25.
Phacotus, 33.
Phacus, 25, 27.
Phalansterium, 38.
Phascolodon, 42.
Phyllomitus, 29, 31.
Pinaciophora, 17.
Plakopus, 12.
Platoum, 14.
Platytrichotus, 57, 59.
Pleuromonas, 30, 42.
Pleuronema, 42, 50.
Pleurotricha, 57, 59.
Podophrya, 65, 66.
Polytoma, 32, 35.
Pompholyxophrys, 17.
Poteriodendron, 20.
Prorodon, 40, 45.
Protamœba, 12.
Protospongia, 38.
Protozoa, 11.
Pseudochlamys, 12.
Pseudodifflugia, 13.
Psilotricha, 57.
Pyxidicula, 12.
Pyxidium, 63, 64.
Quadrula, 13, 15.
Rhabdomonas, 25.
Rhabdostyla, 63, 64.
Rhaphidiophrys, 17, 18.
Rhipidodendron, 34.
Rhizopoda, 11.
Rhyncheta, 65.
Rhynchomonas, 21, 23.
Salpingœca, 38.
Scyphidia, 62.
Solenophrya, 65.
Spathidium, 40, 44.
Sphærophrya, 65.
Sphærastrum, 17.
Sphenomonas, 26, 29.
Spiromonas, 29, 31.
Spirostomun, 53, 55.
Spondylomorum, 34, 37.
Spongomonas, 34.
Stentor, 54, 55.
Stephanosphæra, 34.
Stichotricha, 56, 58.
Strombidium, 57, 62.
Stylochrysalis, 33.
Stylonychia, 60.
Suctoria, 11, 65.
Syncrypta, 34.
Synura, 34, 37.
Tetramitus, 33.
Tetraselmis, 33.
Tintinnidium, 54.
Tintinnus, 54.
Trachelius, 40, 46.
Trachelophyllum, 40, 45.
Trachelomonas, 25, 27.
Trepomonas, 32, 35.
Trichodina, 62, 63.
Trichogaster, 56.
Trichomastix, 33, 36.
Trichophrya, 65.
Trinema, 13.
Trochilia, 42.
Tropidoscyphus, 26.
Urceolopsis, 25.
Urceolus, 25, 28.
Urnula, 65.
Urocentrum, 42, 51.
Uroglena, 21, 23.
Uroleptus, 57, 58.
Uronema, 41, 49.
Urosoma, 57, 59.
Urostyla, 56, 58.
Urotricha, 40, 43.
Vaginicola, 63.
Vampyrella, 17, 18.
Volvox, 34.
Vorticella, 63.
Zoöthamnium, 63, 64.
Zygoselmis, 26.

PLATE I; FIGS. 1 TO 9; ALL MAGNIFIED 500 DIAMETERS.

Fig. 1. *Amœba protens* Ehr. . . . . p. 14
Fig. 2. *Hyalodiscus limax* Duj. . . . . p. 14
Fig. 3. *Hyalodiscus guttula* Duj. . . . . p. 14
Fig. 4. *Hyalodiscus guttula* Duj. . . . . p. 14
Fig. 5. *Amœba verrucosa* Ehr. . . . . p. 14
Fig. 6. *Amœba verrucosa* Ehr. . . . . p. 14
Fig. 7. *Pelomyxa* (?) . . . . . p. 14
Fig. 8. *Hyalodiscus limax* Duj. . . . . p. 14
Fig. 9. *Dactylosphærium radiosum* Ehr. . . . . p. 14

PLATE I.

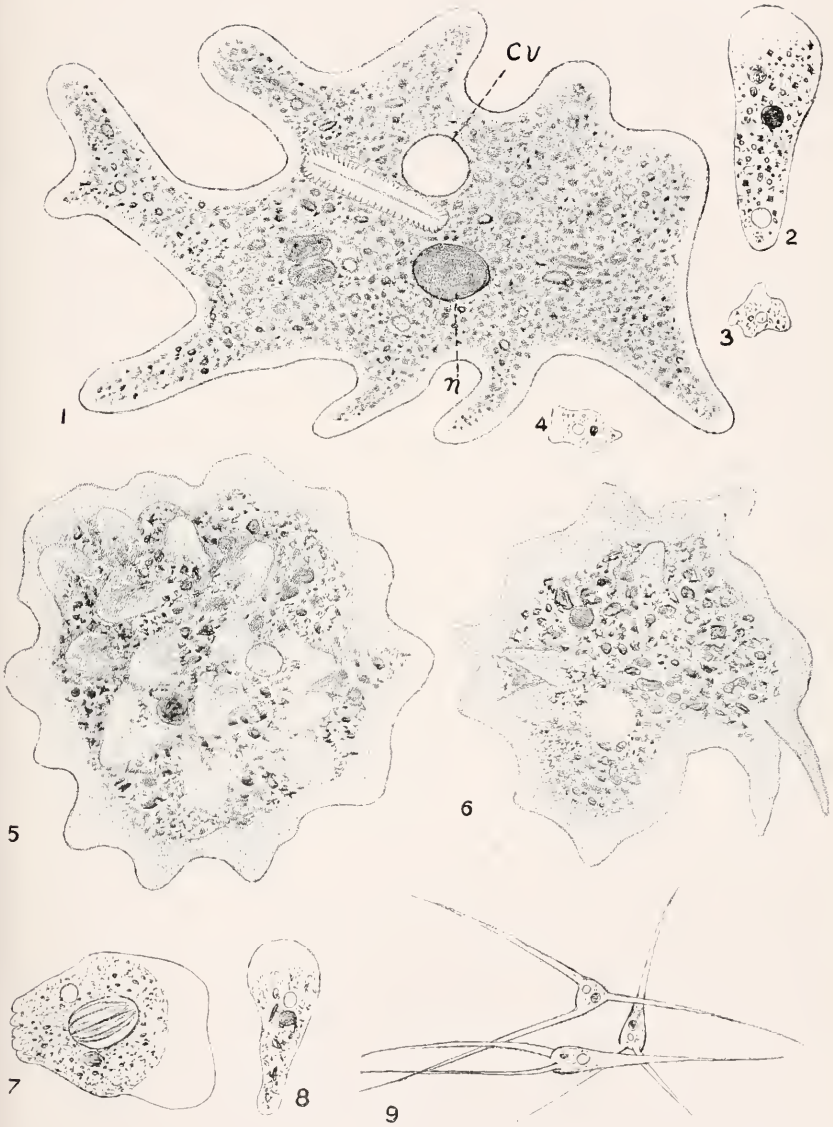
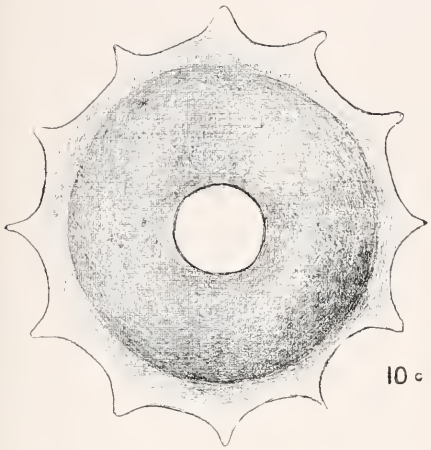


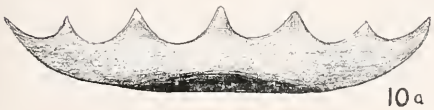
PLATE II; FIGS. 10 TO 16; ALL MAGNIFIED 500 DIAMETERS.

Fig. 10. *Arcella dentata* Ehr. Fig. 10*a* side view.p. 15
Fig. 11. *Arcella vulgaris* Ehr.....p. 15
Fig. 12. *Lecquereusia (Difflugia) spiralis* Ehr...p. 15
Fig. 13. *Centropyxis aculeata* Stein.....p. 15
Fig. 14. *Difflugia globostoma* Leidy.....p. 15
Fig. 15. *Cyphoderia ampulla* Ehr.....p. 16
Fig. 16. *Difflugia lobostoma* Ehr.....p. 15

PLATE II.

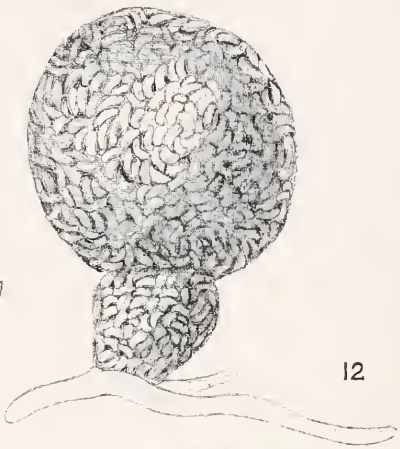


10 c

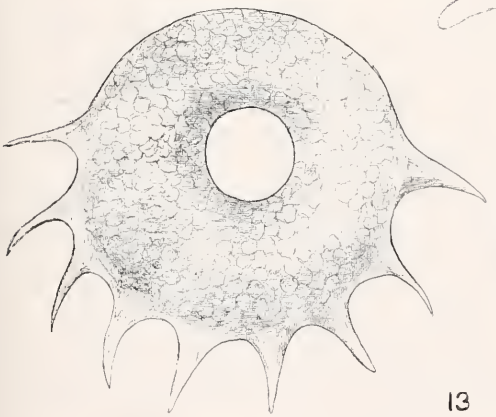


10 a

11

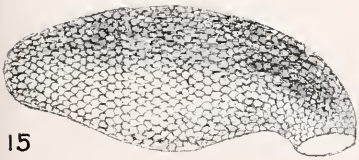


12

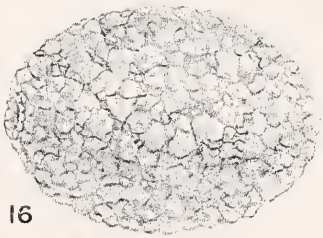


13

14



15



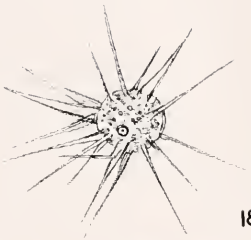
16

PLATE III; FIGS. 17 TO 21; ALL MAGNIFIED 500 DIAMETERS.

Fig. 17. *Difflugia pyriformis* Perty.....p. 15
Fig. 18. *Nuclearia simplex* Cienk.....p. 18
Fig. 19. *Difflugia cratera* Leidy.....p. 15
Fig. 20. *Quadrula symmetrica* Ehr.....p. 15
Fig. 21. *Microgromia* (?) .....p. 16

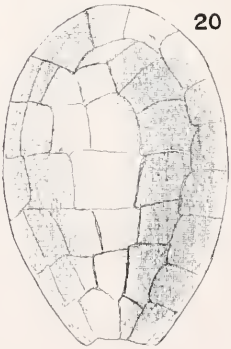
PLATE III.

17

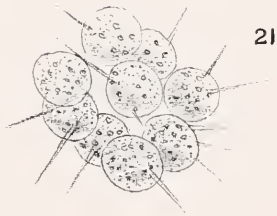


18

19



20



21

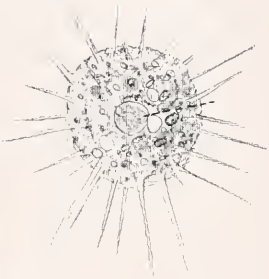
PLATE IV; FIGS. 22 TO 26; ALL MAGNIFIED 500 DIAMETERS.

Fig. 22. *Difflugia corona* Wall.....p. 15
Fig. 23. *Nuclearia simplex* Cienk.....p. 18
Fig. 24. *Euglypha alveolata* Duj.....p. 16
Fig. 25. *Vampyrella lateritia* Fres.....p. 18
Fig. 26. *Actinophrys sol* Ehr.....p. 18

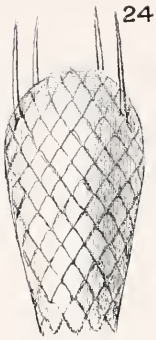
PLATE IV.

22

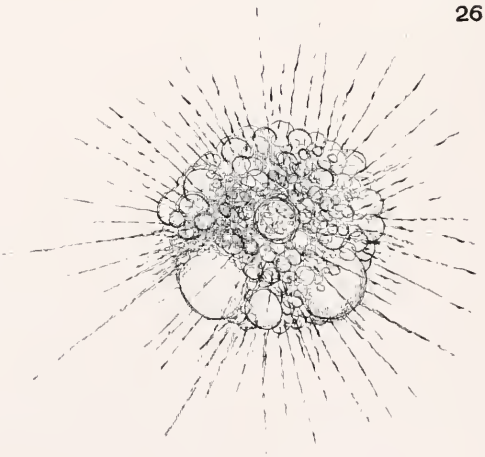
23



24



26



25

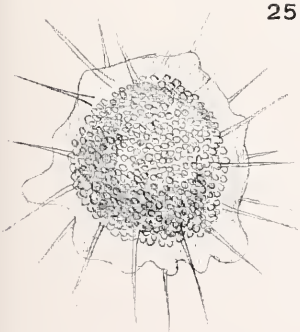


PLATE V; FIGS. 27 TO 31; ALL MAGNIFIED 500 DIAMETERS.

Fig. 27. *Difflugia acuminata* Ehr. Fig. *27a* represents the outline of a quite differently shaped variety ..... p. 15
Fig. 28. *Clathrulina elegans* Cienk..... p. 18
Fig. 28. *Diplophrys archeri* Bark..... p. 16
Fig. 30. *Pamphagus (Lecythium) hyalinum* H. & L..... p. 16
Fig. 31. *Rhaphidiophrys elegans* H. & L..... p. 18

PLATE V.

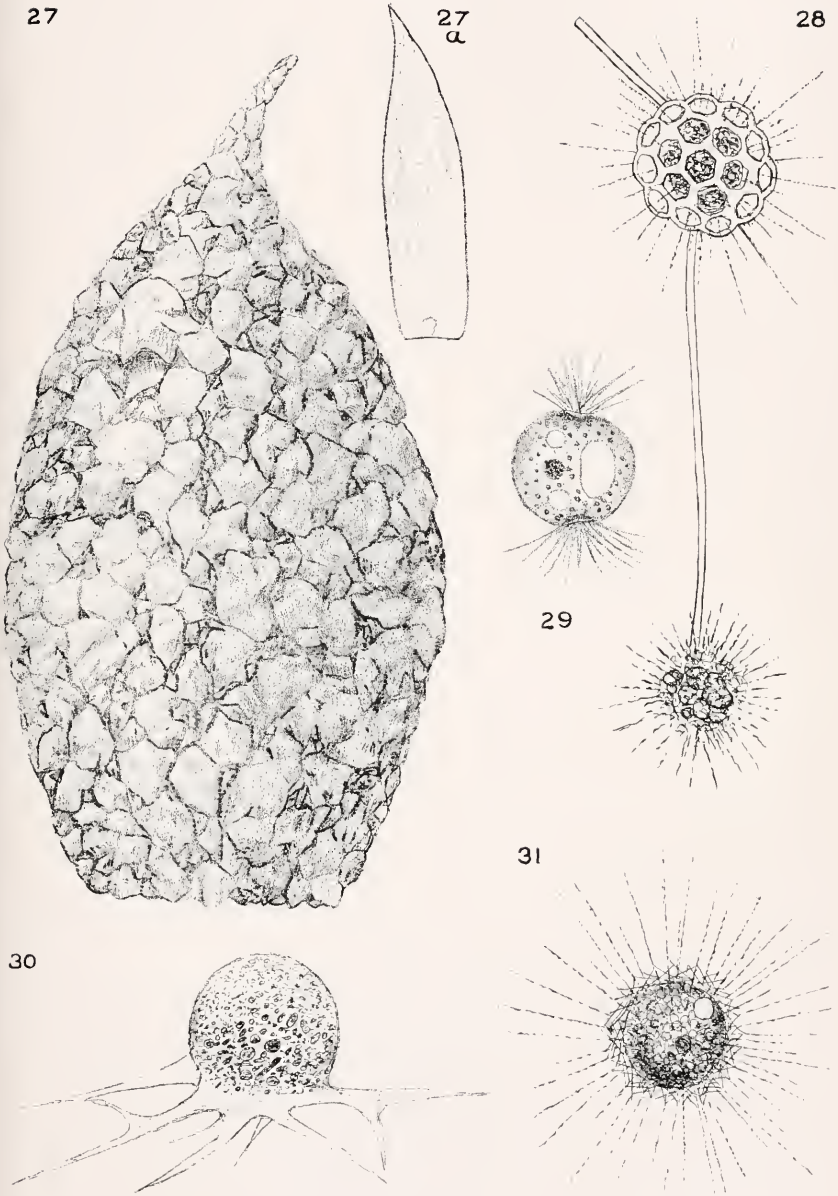


PLATE VI; FIGS. 32 TO 49; MAGNIFIED 1000 DIAMETERS.

Fig. 32. *Mastigamœba reptans* Stokes.....p. 21
Fig. 33. *Mastigamœba longifilum* (?) Stokes....p. 21
Fig. 34. *Cercomonas longicaudata* Duj.....p. 22
Fig. 35. *Cercomonas crassicanda* Duj.....p. 22
Fig. 36. *Cercobodo (Dimorpha)* sp. (?).....p. 21
Fig. 37. *Notosolenus orbicularis* Stokes.....p. 22
Fig. 38. *Notosolenus* sp. (?).....p. 22
Fig. 39. *Notosolenus* sp. (?).....p. 22
Fig. 40. *Oikomonas* sp. (?).....p. 22
Fig. 40a. *Oikomonas* sp. (?).....p. 22
Fig. 41. *Physomonas elongata* (?) Stokes.....p. 22
Fig. 42. *Leptomonas* sp. (?).....p. 23
Fig. 43. *Ochromonas* sp. (?).....p. 36
Fig. 44. *Dinobryon sertularia* Ehr.....p 23
Fig. 45. *Englena viridis* Ehr .....p. 26
Fig. 46. *Cephalothamnium cæspitosum* (?) S. K..p. 23
Fig. 47. *Anthophysa vegetans* Stein.....p. 23
Fig. 48. *Eutreptia viridis* Perty.....p. 27
Fig. 49. *Uroglena americana* Calk.....p. 23

PLATE VI.

PLATE VII; FIGS. 50 TO 71; MAGNIFIED 1000 DIAMETERS.

Fig. 50. *Euglena* sp. (?).....p. 26
Fig. 51. *Euglena deses* Ehr.....p. 26
Fig. 52. *Euglena* (?).....p. 26
Fig. 53. *Trachelomonas lagenella* Stein.....p. 27
Fig. 54. *Trachelomonas hispida* Stein.....p. 27
Fig. 55. *Chloropeltis hispidula* Stein-Eichwald...p. 28
Fig. 56. *Euglena spirogyra* (?) Ehr.....p. 26
Fig. 57. *Euglena* sp. (?).....p. 26
Fig. 58. *Mallomonas acaroides* Perty.....p. 24
Fig. 59. *Trachelomonas volvocina* Ehr.....p. 27
Fig. 60. *Mallamonas* sp. (?) Fig. 60*a* is a cross section .....p. 24
Fig. 61. *Lepocinclis* sp. (?).....p. 27
Fig. 62. *Phacus pyrum* Ehr.....p. 27
Fig. 63. *Phacus pleuronectes* Nitz.....p. 27
Fig. 64. *Phacus* sp. (?).....p. 27
Fig. 65. *Rhynchomonas nasuta* Klebs.....p. 23
Fig. 66. *Pleuromonas jaculans* Perty.....p. 30
Fig. 67. *Dinomonas vorax* S. K.....p. 31
Fig. 68. *Phyllomitus amylophagus* Klebs.....p. 31
Fig. 69. *Urceolus* sp. (?).....p. 28
Fig. 70. *Peranema* sp. (?).....p. 28
Fig. 71. *Peranema* sp. (?). Fig. 71*a* is probably the same showing variation in appearance of the cell contents.....p. 28

PLATE VII.

50
51
52
53
54
55
56
X500
58
59
X500
57
60
X500
61
62
X500
X500
63
64
60a
65
X500
X500
68
67
69
70
66
X500
X500
71
71a

PLATE VIII; FIGS. 72 TO 96: MAGNIFIED 1000 DIAMETERS.

Fig. 72. *Peranema trichophora* (?) The figures at the right show the peculiar motions of the body, all of the contortions shown following each other in a few seconds. . p. 28
Fig. 73. *Astasia* sp. (?) . . . . . p. 29
Fig. 74. *Peranema trichophora* Ehr. . . . . p. 28
Fig. 75. *Anisonema* sp. (?) . . . . . p. 31
Fig. 76. *Anisonema obliqua* (?) Stokes. . . . . p. 31
Fig. 77. *Heteromita* (*Bodo*) *ovata* Stokes. . . . . p. 30
Fig. 78. *Heteromita* sp. (?) . . . . . p. 30
Fig. 79. *Heteromita globosa* Stokes. . . . . p. 30
Fig. 80. *Anisonema acinus* Duj. . . . . p. 31
Fig. 81. *Metanema* sp. (?) . . . . . p. 31
Figs. 82 to 85. *Heteromita variabilis* Stokes. . . . . p. 30
Fig. 86. *Heteromita acus* Stokes. . . . . p 30
Fig. 87. *Atractonema tortuosa* Stokes. . . . . p. 28
Fig. 88. *Clostonema socialis* Stokes. . . . . p. 29
Fig. 89. *Entosiphon sulcatus* Duj. . . . . p. 32
Fig. 90. *Clostonema socialis* (?) Stokes. . . . . p. 29
Fig. 91. *Chilomonas paramecium* Ehr. . . . . p. 35
Fig. 92. *Salpingœca steinii* S. K. . . . . p. 38
Fig. 93. *Cryptoglena pigra* Ehr. . . . . p. 26
Fig. 94. *Heteronema globiformis* (?) Ehr. 94*a* a side view. . . . . p. 32
Fig. 95. *Chilomonas* sp. (?) . . . . . p. 35
Fig. 96. *Bodo globosus* Duj. Perhaps the same as Fig. 79. . . . . p 30
Fig. 97. *Hexamitus inflatus* Duj. . . . . p. 36
Fig. 98. *Hexamitus inflatus*. . . . . p. 36
Fig. 99. *Cryptomonas ovata* Ehr. *a*, *b*, and *c* different varieties. . . . . p. 36
Fig. 100. *Elvirea cionæ* Parona. . . . . p. 31

PLATE VIII.

72
73
X 500
74
X500
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89
90
91
92
CV
n
X 500
X500
93
94
95
94a
96
97
98
99a
99b
99c
100

PLATE IX; FIGS. 101 TO 118; MAGNIFIED 1000 DIAMETERS.

Fig. 101. *Polytoma uvella* Ehr.....p. 35
Fig. 102. *Codonosiga botrytis* Clark.....p. 38
Fig. 103. *Astasia contorta* (?) Duj.....p. 29
Fig. 104. *Synura uvella* Ehr.....p. 37
Fig. 105. *Hexamitus spiralis* (?) Stokes.....p. 36
Fig. 106. *Monosiga ovata* S. K.....p. 38
Fig. 107. *Cladonocladium umbellatum* Tat.....p. 38
Fig. 108. *Spondylomorum quaternarium* Ehr. Fig. shows method of division.....p. 37
Fig. 109. *Pandorina elegans* Ehr.....p. 37
Fig. 110. *Spiromonas volubilis* (?) Perty.....p. 31
Fig. 111. *Cyathomonas truncata* From.....p. 35
Fig. 112. *Cyathomonas* sp. (?) The lower figure shows a side view.....p. 35
Fig. 113. *Hexamitus inflatus* (?).....p. 36
Fig. 114. *Chlorangium* sp. (?).....p. 37
Fig. 115. *Trepomonas agilis* Duj.....p. 35
Fig. 116. *Chlamydomonas* sp. (?).....p. 37
Fig. 117. *Amphimonas* (?) The two figures are perhaps the same.....p. 34
Fig. 118. *Trichomastix* sp. (?).....p. 36

PLATE IX.

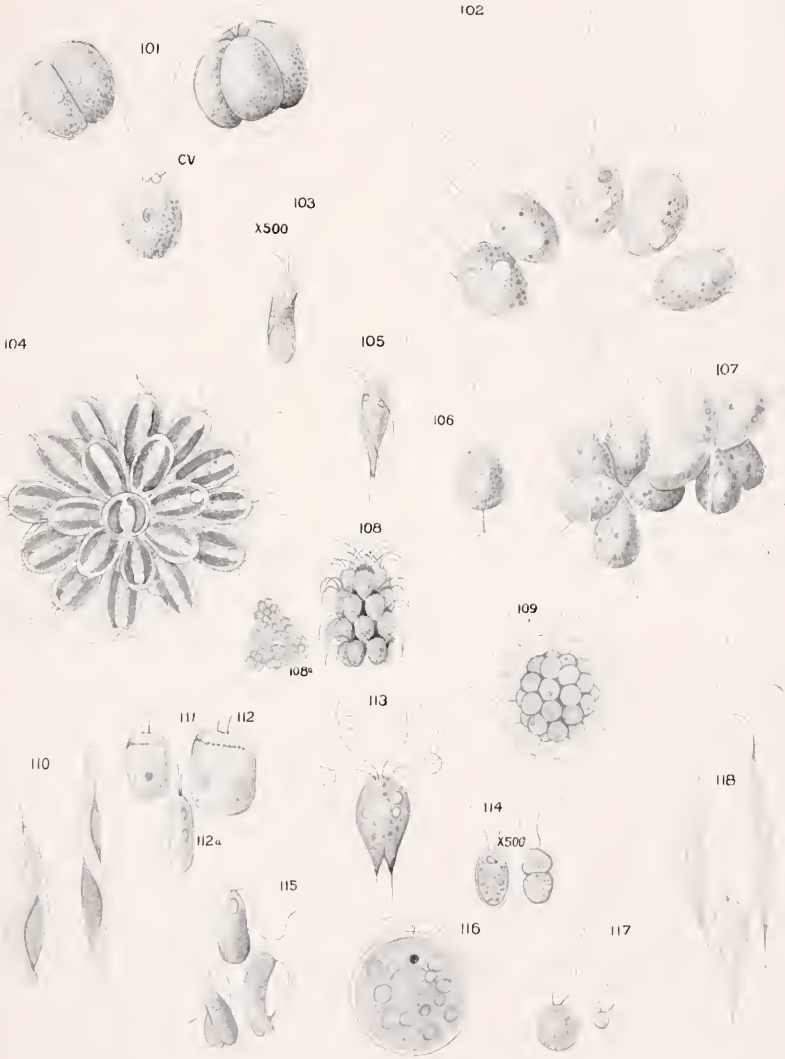

101
102
CV
103
×500
104
105
106
107
108
108a
109
110
111
112
112a
113
114
×500
115
116
117
118

PLATE X; FIGS. 119 TO 135; MAGNIFIED 500 DIAMETERS.

Figs. 119 to 123 are varieties of the genus *Holophrya* for which no specific determinations have been made.....p. 43

Figs. 124 to 126 are provisionally placed in the genus *Enchelys*.....p. 44

Fig. 127. *Ulotricha farcta* C. & L.....p. 43

Fig. 128. *Enchelys pupa* (?) Ehr.....p. 44

Fig. 129. *Spathidium* sp. (?).....p. 44

Fig. 130. *Balantozoon agile* Stokes.....p. 43

Fig. 131. *Spathidium spathula* Duj.....p. 44

Fig. 132. *Holophrya* (?).....p. 43

Fig. 133. *Lionotus* sp. (?).....p. 51

Fig. 134. *Enchelys* sp. (?).....p. 44

Fig. 135. *Mesodinium* sp. (?).....p. 51

PLATE X.

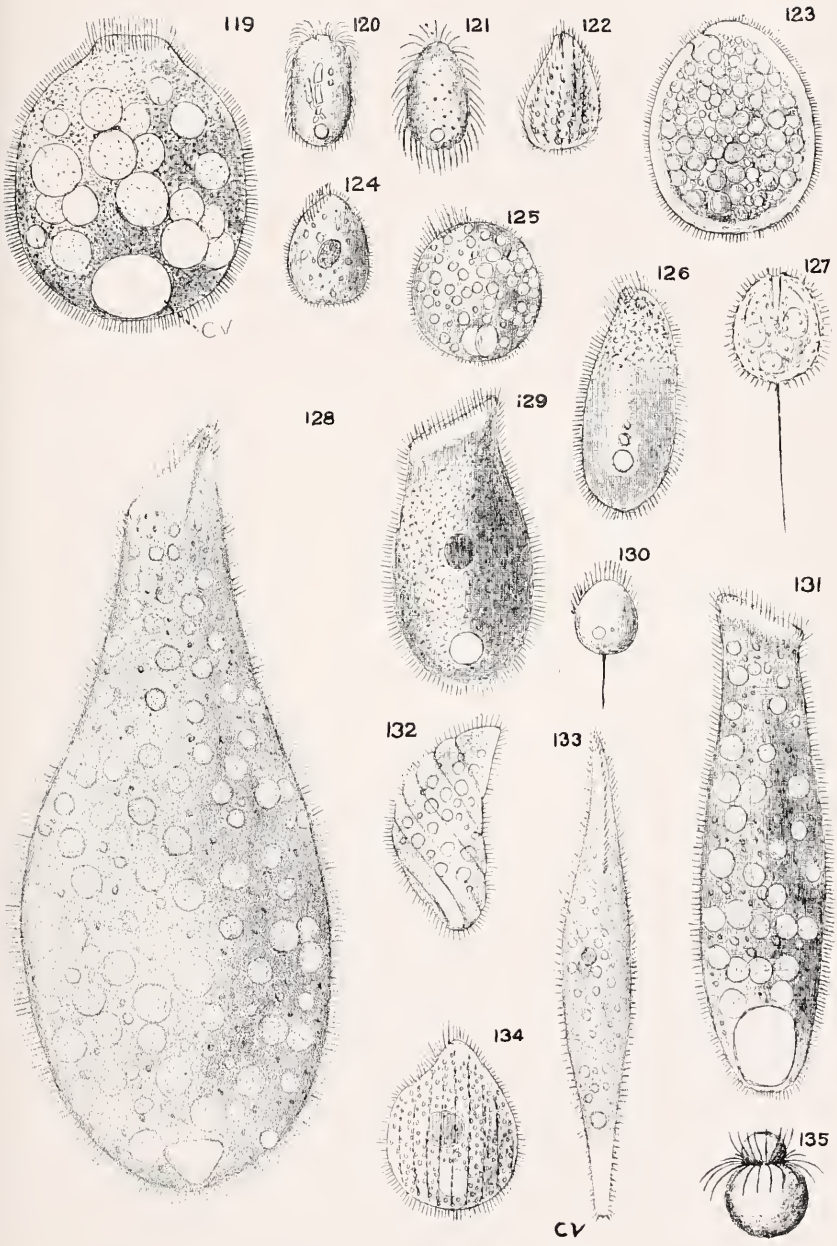

119
CV
120
121
122
123
124
125
126
127
128
129
130
131
132
133
134
135
CV

PLATE XI; FIGS. 136 TO 148; MAGNIFIED 500 DIAMETERS.

Fig. 136. *Prorodon niveus* Ehr. . . . . p. 45
Fig. 137. *Prorodon armatus* (?) C. & L. Fig. 137*a* shows the same animal in a different condition of food absorption. . . . . p. 45
Fig. 138. *Chœnia* sp. (?) . . . . . p. 43
Fig. 139. *Chœnia* sp. (?) . . . . . p. 43
Fig. 140. *Chœnia teres* Duj. . . . . p. 43
Fig. 141. *Chœnia teres* (?) . . . . . p. 43
Fig. 142. *Chœnia* (?) . . . . . p. 43
Fig. 143. *Amphileptus gutta* (?) Clap. . . . . p. 46
Fig. 144. *Prorodon griseus* C. & L. . . . . p. 45
Fig. 145. *Trachelius ovum* Ehr. . . . . p. 46
Fig. 146. *Lionotus* sp. (?) . . . . . p. 51
Fig. 147. *Lionotus fasciola* Ehr. . . . . p. 51
Fig. 148. *Trachilius* sp. (?) . . . . . p. 46

PLATE XI.

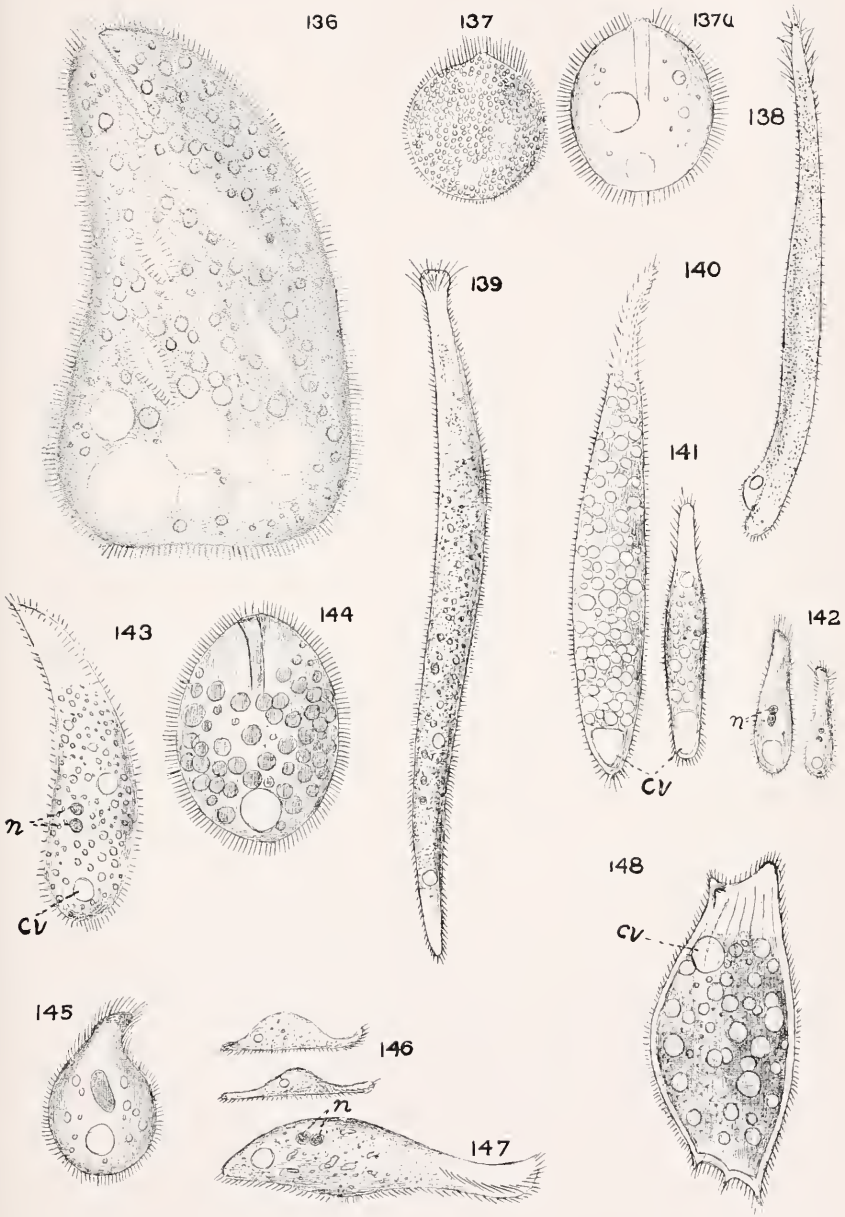


PLATE XII; FIGS. 149 TO 155; MAGNIFIED 500 DIAMETERS.

Fig. 140. *Lacrymaria olor* O. F. Müll. Fig. 149*a* is the same animal contracted.....p. 45
Fig. 150. *Lacrymaria* sp. (?).....p. 45
Fig. 151. *Amphileptus* sp. (?).....p. 46
Fig. 152. *Lacrymaria lagenula* C. & L.....p. 45
Fig. 153. *Coleps hirtus* O. F. Müll.....p. 42
Fig. 154. *Loxodes rostrum* O. F. Müll.....p. 52
Fig. 155. *Lionotus werzesmowsky* S. K.....p. 51

PLATE XII.

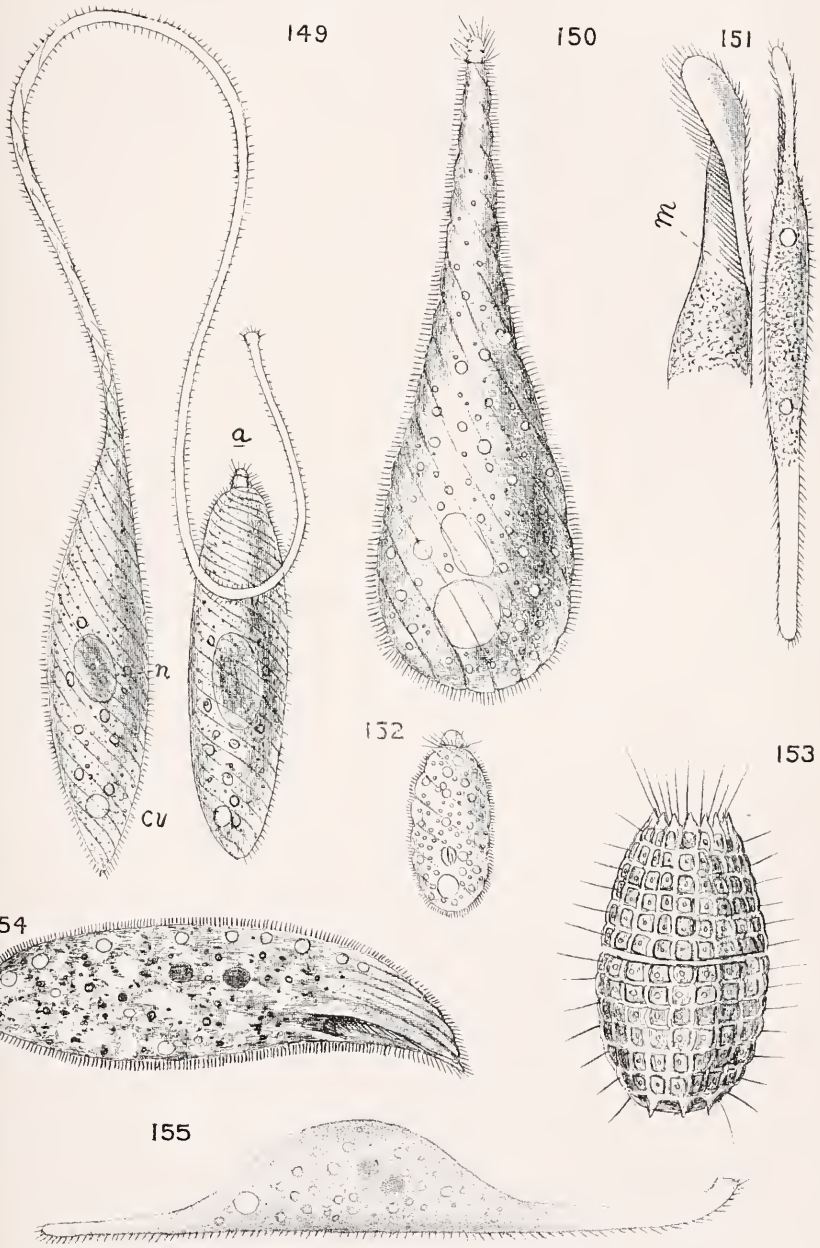


PLATE XIII; FIGS. 156 TO 160; MAGNIFIED 450 DIAMETERS.

Fig. 156. *Trachelophyllum* sp. (?) ..... p. 45
Fig. 157. *Dilcptus monilatus* Stokes ..... p. 46
Fig. 158. *Dilcptus gigas* (?) C. & L. ..... p. 46
Fig. 159. *New genus* ..... p. 52
Fig. 160. *Dilcptus* sp (?) ..... p. 46

PLATE XIII.

PLATE XIV; FIGS. 161 TO 173; MAGNIFIED 500 DIAMETERS.

Fig. 161. *Loxophyllum rostratum* Cohn.....p. 46
Fig. 162. *Loxophyllum* sp. (?).....p. 46
Fig. 163. *Loxophyllum lamella* Ehr. *a*, dorsal view; *b*, side view.....p. 46
Fig. 164. *Nassula* sp. (?).....p. 47
Fig. 165. *Loxophyllum* sp. (?).....p. 46
Fig. 166. *Chilodon caudatus* Stokes.....p. 52
Fig. 167. *New genus* (?) 167*a* end view.....
Fig. 168. *Chilodon megalotrocha* Stokes.....p. 52
Fig. 169. *Nassula ornata* Ehr.....p. 47
Fig. 170. *Nassula ornata* in the act of feeding.....p. 53
Fig. 171. *Glaucoma scintillans* Ehr.....p. 49
Fig. 172. *Chilodon* sp. (?).....p. 52
Fig. 173. *Chilodon caudatus* (?) Stokes.....p. 52

PLATE XIV.

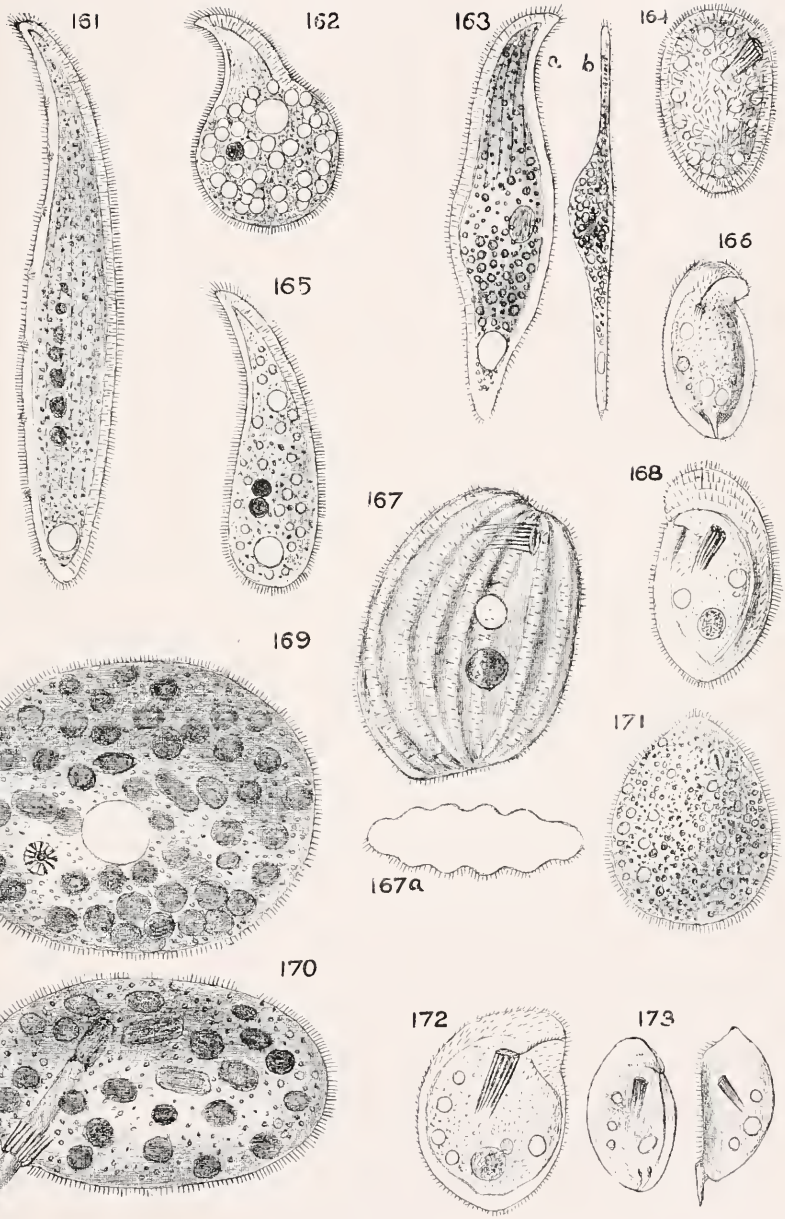


PLATE XV: FIGS. 174 TO 184: MAGNIFIED 500 DIAMETERS.

Fig. 174. *Chilodon cucullus* Müll.....p. 52
Fig. 175. *Dallasia frontinia* Stokes.....p. 49
Fig. 176. *Colpidium striatum* Stokes.....p. 49
Fig. 177. *Colpidium* sp. (?).....p. 49
Fig. 178. *Colpidium* sp. (?).....p. 49
Fig. 179. *Colpidium* sp. (?).....p. 49
Fig. 180. *Chilodon vorax* Stokes.....p. 52
Fig. 181. *Uronema marina* Duj.....p. 49
Fig. 182. *Glaucoma scintillans* Ehr.....p. 49
Fig. 183. *Colpidium* sp. (?).....p. 49
Fig. 184. *New genus* (?). Upper figure as seen from the end, lower figure from the side.....p. 53

PLATE XV.

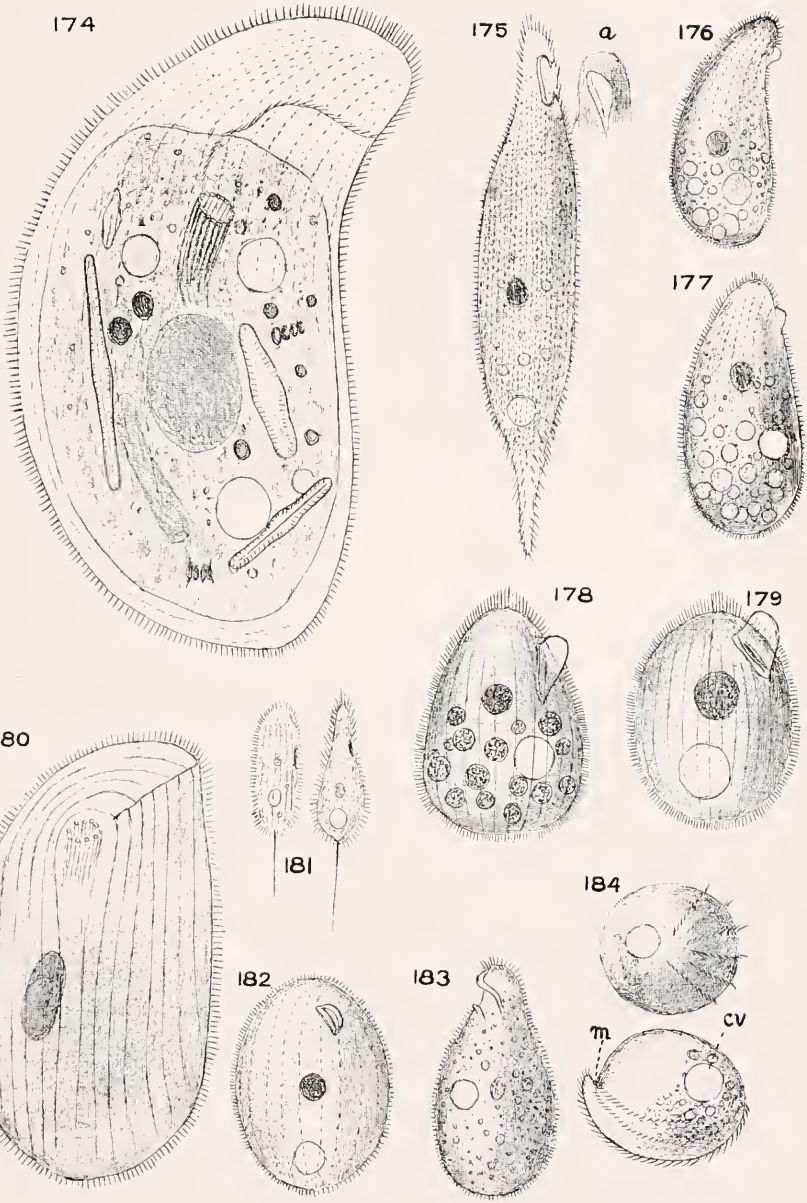


PLATE XVI; FIG. 185; MAGNIFIED 400 DIAMETERS.

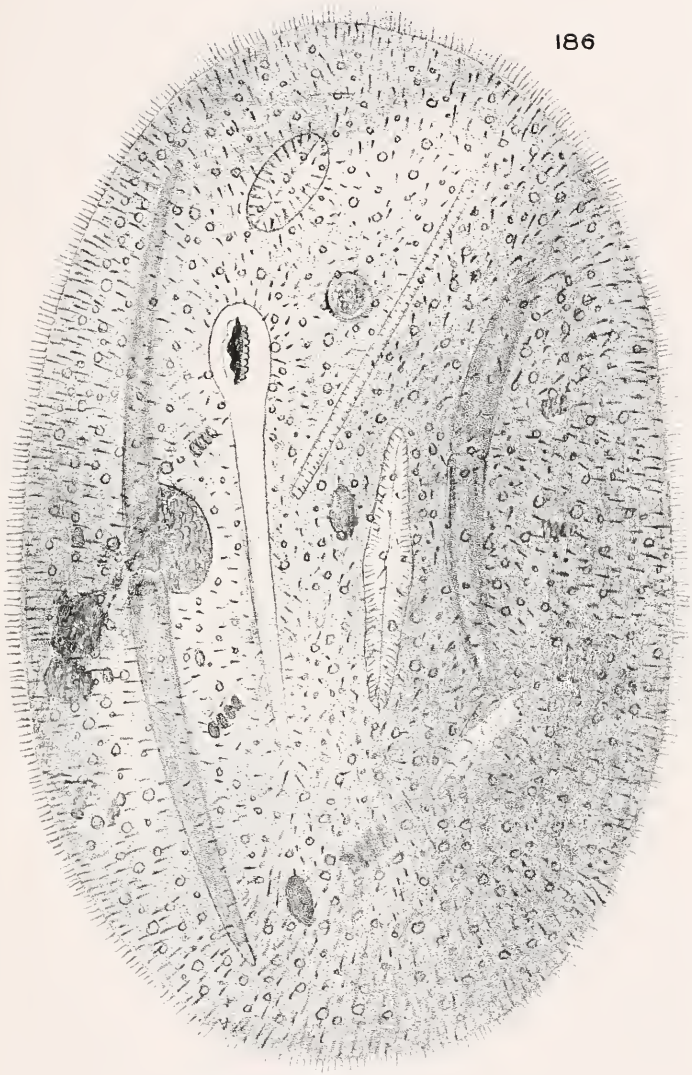
Fig. 185. *Frontonia* sp. (?) ..... p. 47

PLATE XVI.

PLATE XVII. FIGS. 186 TO 193; MAGNIFIED 500 DIAMETERS

Fig. 186. *Frontonia* sp. (?).....p. 47
Fig. 187. *Colpoda* sp. (?).....p. 48
Fig. 188. *Colpoda campyla* Stokes.....p. 48
Fig. 189. *Colpoda saprophylla* Stokes.....p. 48
Fig. 190. *Colpoda saprophylla* (?).....p. 48
Fig. 191. *Colpoda* sp. (?).....p. 48
Fig. 192. *Colpoda inflata* Stokes.....p. 48
Fig. 193. *Colpoda* sp. (?).....p. 48

PLATE XVII.



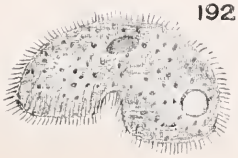
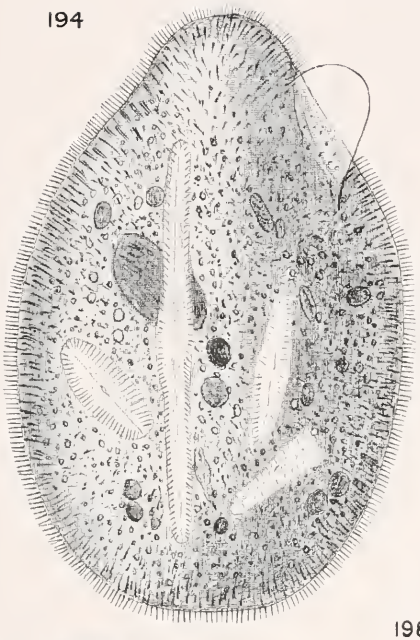
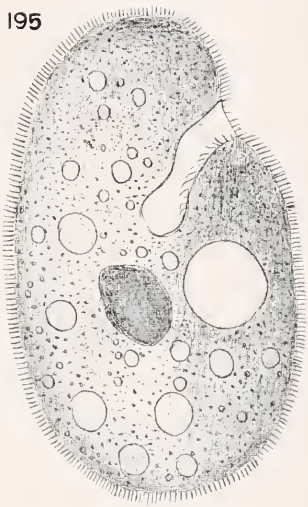


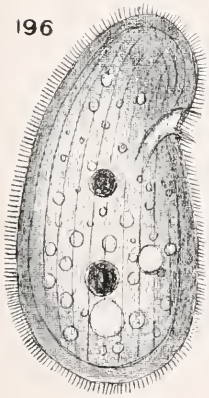
PLATE XVIII; FIGS. 194 TO 200; MAGNIFIED 500 DIAMETERS.

Fig. 194. *Colpidium* sp. (?) ..... p. 49
Fig. 195. *Colpoda* sp. (?) ..... p. 48
Fig. 196. *Colpoda cucullulus* Ehr. ..... p. 48
Fig. 197. *Dexiotricha plagia* Stokes ..... p. 50
Fig. 198. *Frontonia* sp. (?) ..... p. 47
Fig. 199. *Cinctochilum margaretieum* Ehr. ..... p. 50
Fig. 200. *Microthorax sulcatus* Ehr. ..... p. 50

PLATE XVIII.







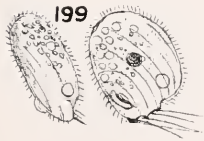


PLATE XIX; FIGS. 201 TO 207; MAGNIFIED 500 DIAMETERS.

Fig. 201. *Paramecium bursaria* Ehr.....p. 48
Fig. 202. *Paramecium bursaria*.....p. 48
Fig. 203. *Paramecium caudatum* Ehr.....p. 48
Fig. 204. *Lambadion bullianum* Perty.....p. 50
Fig. 205. *Colpoda* sp. (?).....p. 48
Fig. 206. *Paramecium trichium* Stokes.....p. 48
Fig. 207. *Trichoda pura* Ehr.....p. 49

PLATE XIX.

PLATE XX; FIGS. 208 TO 221; MAGNIFIED 500 DIAMETERS.

Fig. 208. *Cyclidium*. *a*, *b* and *c* are different forms of perhaps the same species.....p. 51
Fig. 209. *Cyclidium limetosum* Stokes.....p. 51
Fig. 210. *Urocentrum turbo* Müll.....p. 51
Figs. 211 to 215 are different varieties referred to the genus *Pleuronema*.....p. 50
Fig. 216. *Blepharisma* sp. (?).....p. 54
Fig. 217. *Blepharisma undulans* Stein.....p. 54
Fig. 218. *Blepharisma ovata*. (*Apgaria ovata* of Stokes).....p. 54
Fig. 219. *Balantidium coli* (?) C. & L.....p. 56
Fig. 220. *Condylostoma* (?).....p. 54
Fig. 221. *Ophryglena* sp. (?).....p. 47

PLATE XX.

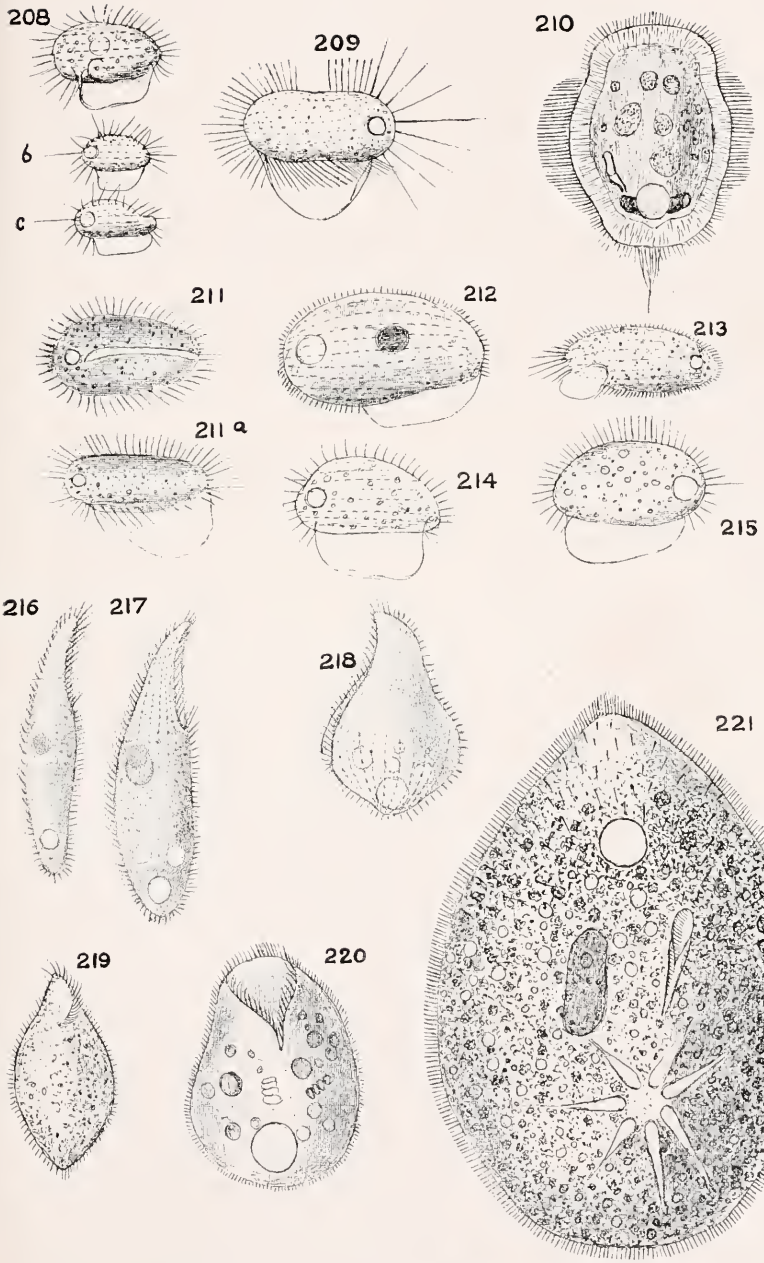


PLATE XXI: FIGS. 222 TO 230; MAGNIFIED 500 DIAMETERS.

Fig. 222. *Spirostomum teres* C. & L. ..... p. 55
Fig. 223. *Metopus sigmoides* C. & L. ..... p. 54
Fig. 224. *Metopus sigmoides* ..... p. 54
Fig. 225. *Metopus sigmoides* sp. (?) ..... p. 54
Fig. 226. *Anoplophrya* sp. (?) ..... p. 43
Fig. 227. *Halteria grandinella* O. F. Müll. Fig. 227*a* is the same animal in process of division ..... p. 62
Fig. 228. *Blepharisma* sp. (?) ..... p. 54
Fig. 229. *Strombidium* sp. (?) ..... p. 62
Fig. 230. *Halteria grandinella* Müll. ..... p. 62

PLATE XXI.

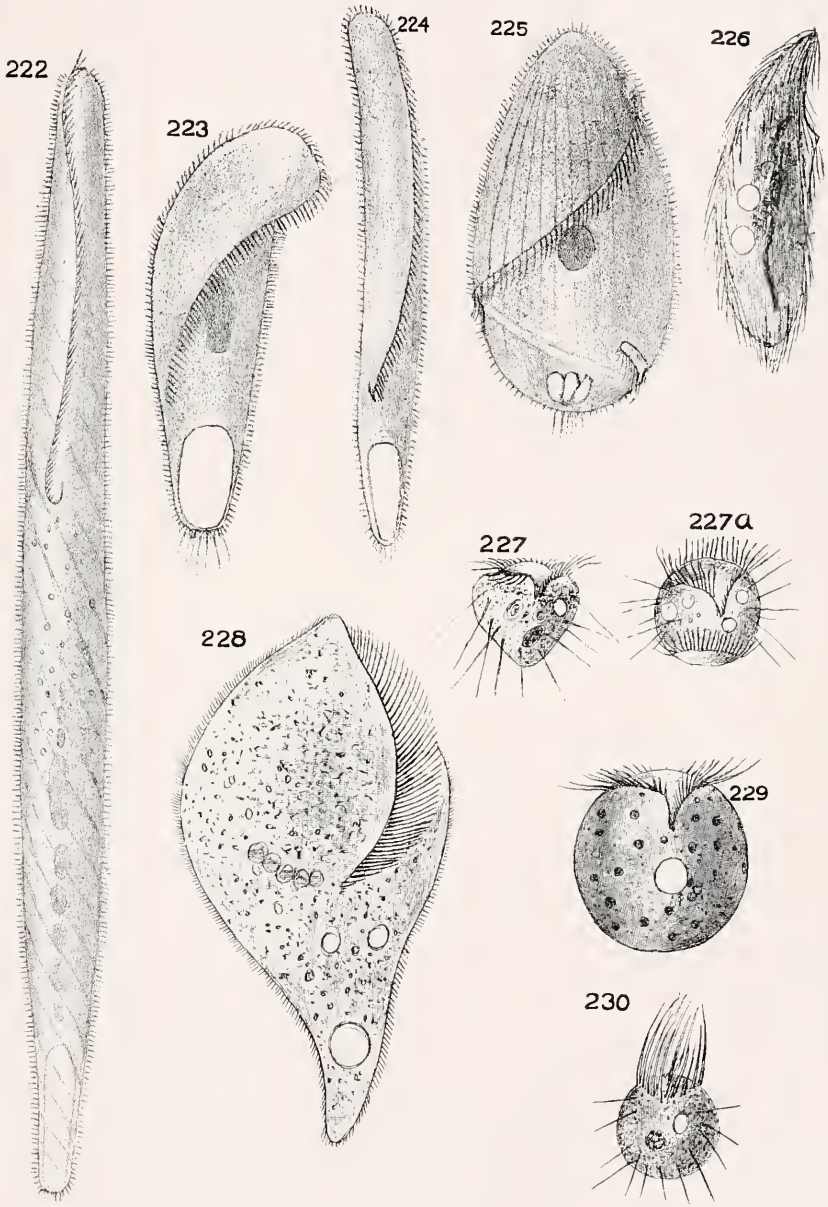
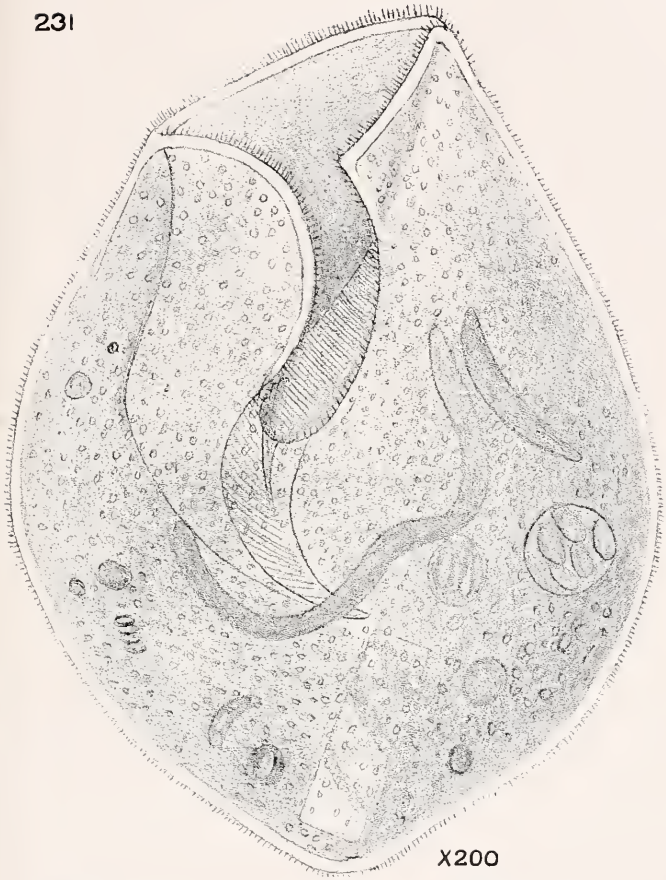


PLATE XXII: FIGS. 231 TO 236; MAGNIFIED 500 DIAMETERS.

Fig. 231. *Bursaria truncatella* Müll.....p. 55
Fig. 232. *Uroleptus longicaudatus* Stokes.....p. 58
Fig. 233. *Uroleptus musculus* Ehr.....p. 58
Fig. 234. *Uroleptus musculus* (?).....p. 58
Fig. 235. *Pleurotricha* sp. (?).....p. 59
Fig. 236. *Stichotricha secunda* Perty.....p. 58

PLATE XXII.

231



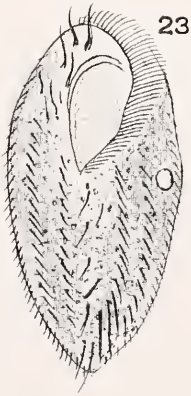
232

X200

233

234

235



236

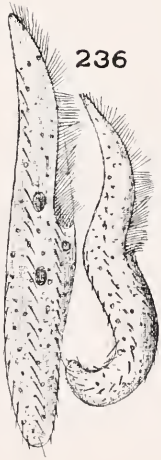


PLATE XXIII; FIGS. 237 TO 239; MAGNIFIED 500 DIAMETERS.

Fig. 237. *Urostyla (Hemicycliostyla) trichota* Stokes ..... p. 58
Fig. 238. *Platytrichotus opisthobolus* Stokes..... p. 59
Fig. 239. *Urostyla vernalis* Stokes..... p. 58

PLATE XXIII.

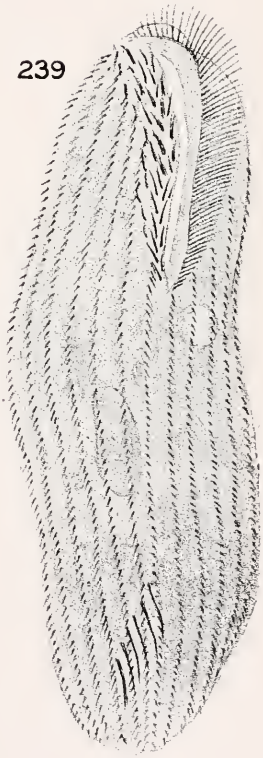


PLATE XXIV; FIGS. 240 TO 244; MAGNIFIED 500 DIAMETERS.

Fig. 240. *Stentor cæruleus* Ehr.....p. 55
Fig. 241. *Urostyla trichogaster* Stokes.....p. 58
Fig. 242. *Holosticha* sp. (?).....p. 60
Fig. 243. *Uroleptus dispar* Stokes.....p. 58
Fig. 244. *Holosticha vernalis* Stokes.....p. 60

PLATE XXIV.

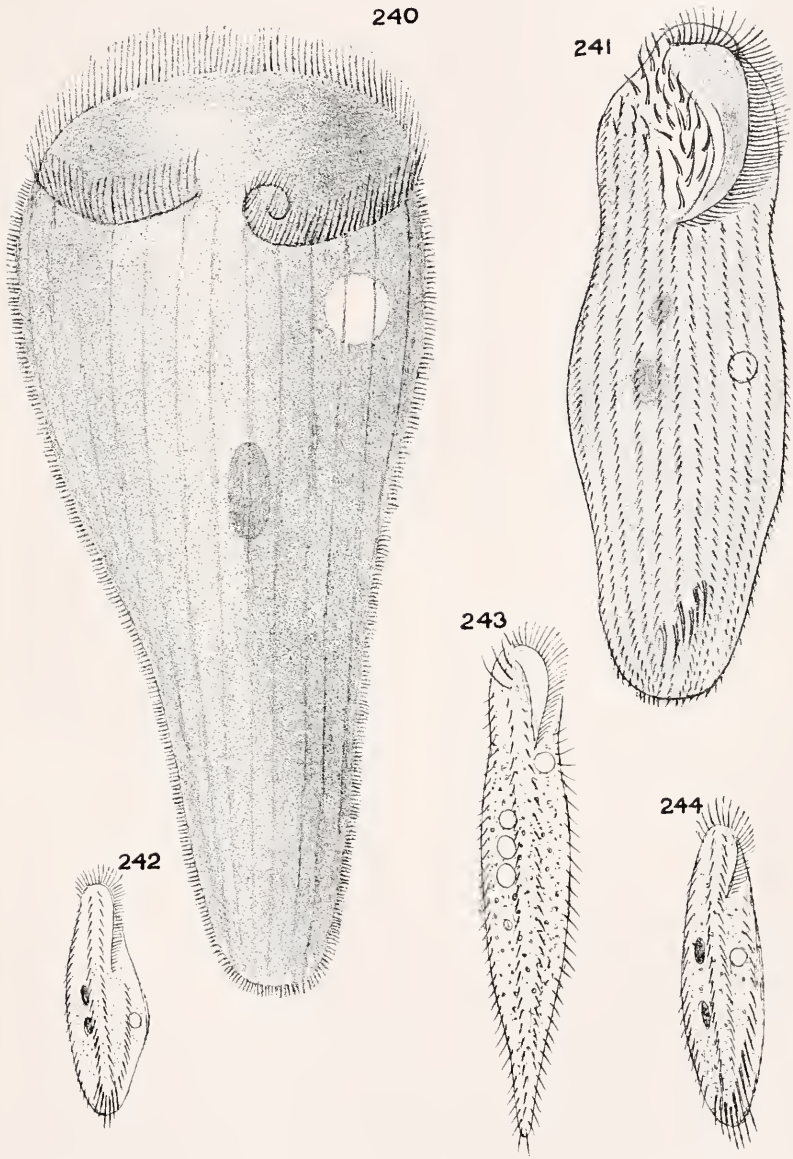


PLATE XXV; FIGS. 245 TO 246; MAGNIFIED 450 DIAMETERS.

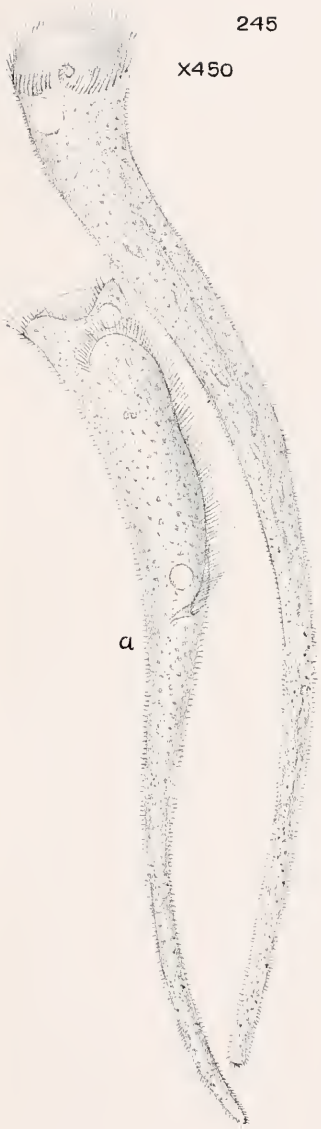
Fig. 245. *Stentor polymorphus* in the state of division ..... p. 55

Fig. 246. *Stentor polymorphus* Ehr. A widely different variety from Fig. 245 ..... p. 55

PLATE XXV.

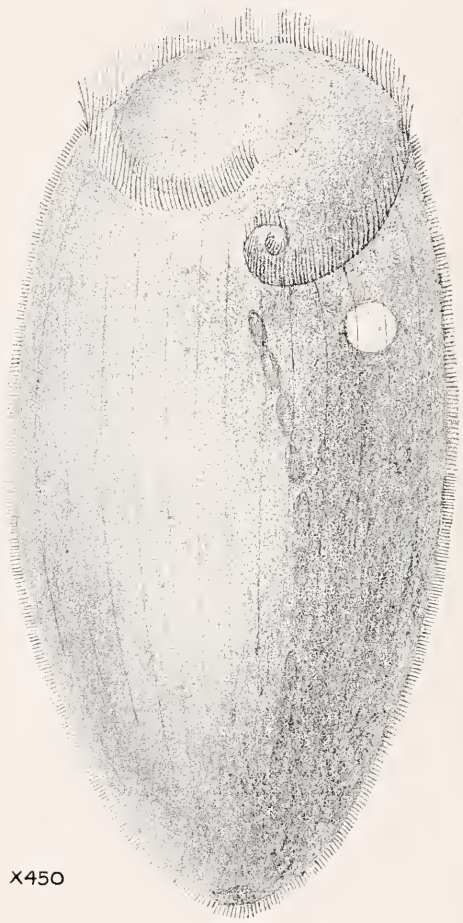
245

X450



a

246



X450

PLATE XXVI; FIGS. 247 TO 249; MAGNIFIED 500 DIAMETERS.

Fig. 247. *Onchodromus grandis* Stein.....p. 59
Fig. 248. *Urosoma cienkowski* (?) Kow.....p. 59
Fig. 249. *Oxytricha pellionella* Müll.....p. 59

PLATE XXVI.

PLATE XXVII; FIGS. 250 TO 257; MAGNIFIED 500 DIAMETERS.

Fig. 250. *Oxytricha bifaria* Stokes.....p. 59
Fig. 251. *Oxytricha fallax* Stein.....p. 59
Fig. 252. *Oxytricha parvistyla* Stokes.....p. 59
Fig. 253. *Oxytricha parvistyla*.....p. 59
Fig. 254. *Oxytricha hymenostoma* Stokes.....p. 59
Fig. 255. *Oxytricha* sp. (?).....p. 59
Fig. 256. *Oxytricha bifaria* Stokes.....p. 59
Fig. 257. *Oxytricha bifaria*.....p. 59

PLATE XXVII.

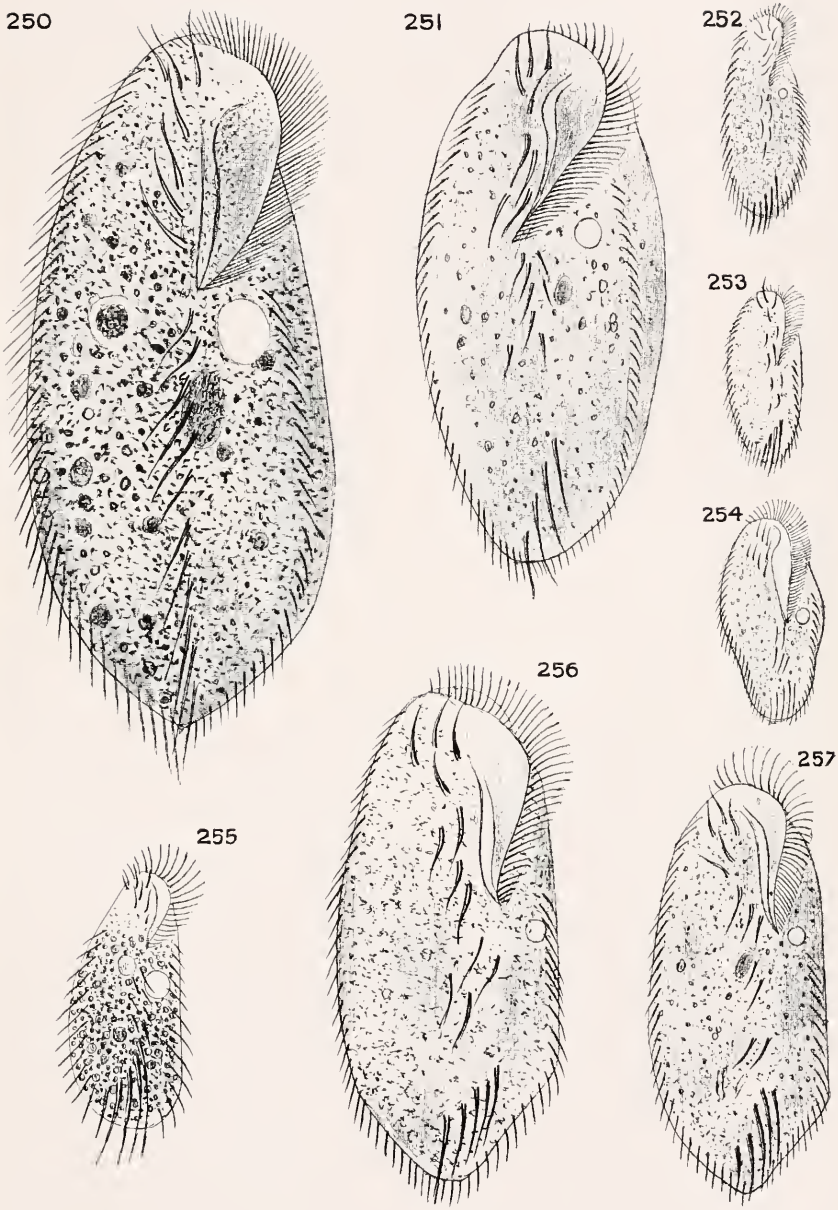
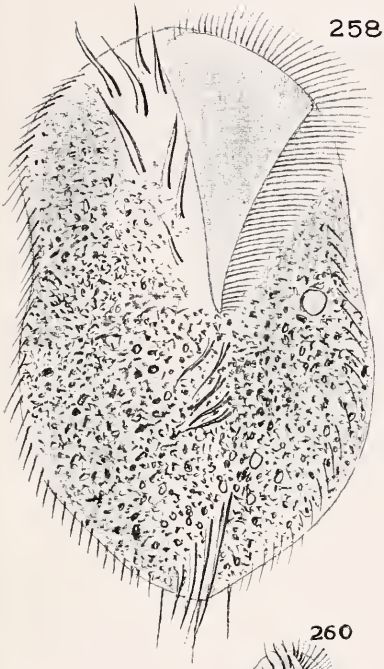
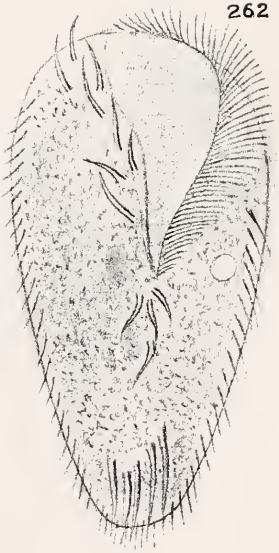


PLATE XXVIII; FIGS. 258 TO 262; MAGNIFIED 500 DIAMETERS.

Fig. 258. *Stylonychia pustulata, var.* Ehr.....p. 60
Fig. 259. *Stylonychia notophora* Stokes.....p. 60
Fig. 260. *Oxytricha agilis* Stokes.....p. 59
Fig. 261. *Oxytricha* sp. (?).....p. 59
Fig. 262. *Histrio* sp. (?).....p. 60
Fig. 263. *Histrio erethisticus* Stokes.....p. 60
Fig. 264. *Histrio complanatus* (?) Stokes.....p. 60
Fig. 265. *Holosticha setigera* (?).....p. 60

PLATE XXVIII.





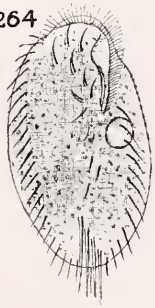
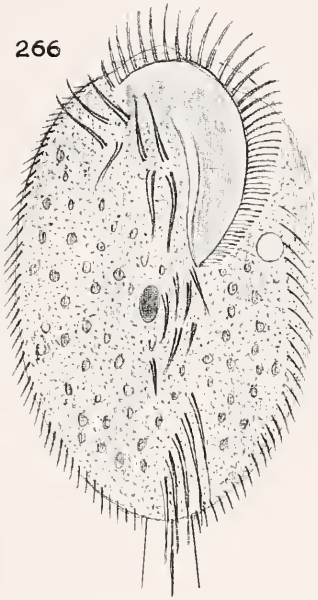
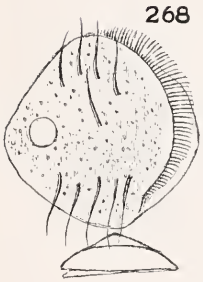


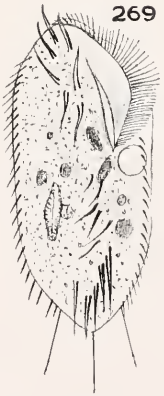
PLATE XXIX; FIGS. 266 TO 272; MAGNIFIED 500 DIAMETERS.

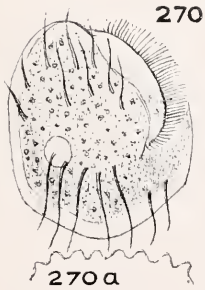
Fig. 266. *Stylonychia pustulata* Ehr.....p. 60
Fig. 267. *Stylonychia* sp. (?).....p. 60
Fig. 268. *Euplotes* sp. (?).....p. 61
Fig. 269. *Stylonychia putrina* Stokes.....p. 60
Fig. 270. *Euplotes carinata* Stokes.....p. 61
Fig. 271. *Euplotes plumipes* Stokes.....p. 61
Fig. 272. *Euplotes charon* Ehr.....p. 61

PLATE XXIX.









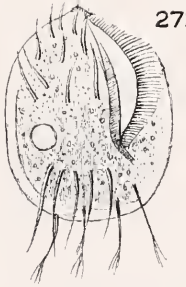


PLATE XXX; FIGS. 273 TO 279; MAGNIFIED 500 DIAMETERS.

Fig. 273. *Stylonychia mytilis* Müll.....p. 60
Figs. 274 to 277 are different forms of *Vorticella*....p. 63
Fig. 278. *Rhabdostyla brevipes* (?) C. & L.....p. 64
Fig. 279. *New genus*.....p. 58
Fig. 280. *Aspidisca* sp. (?).....p. 61
Fig. 281. *Aspidisca costata* Duj.....p. 61

PLATE XXX.

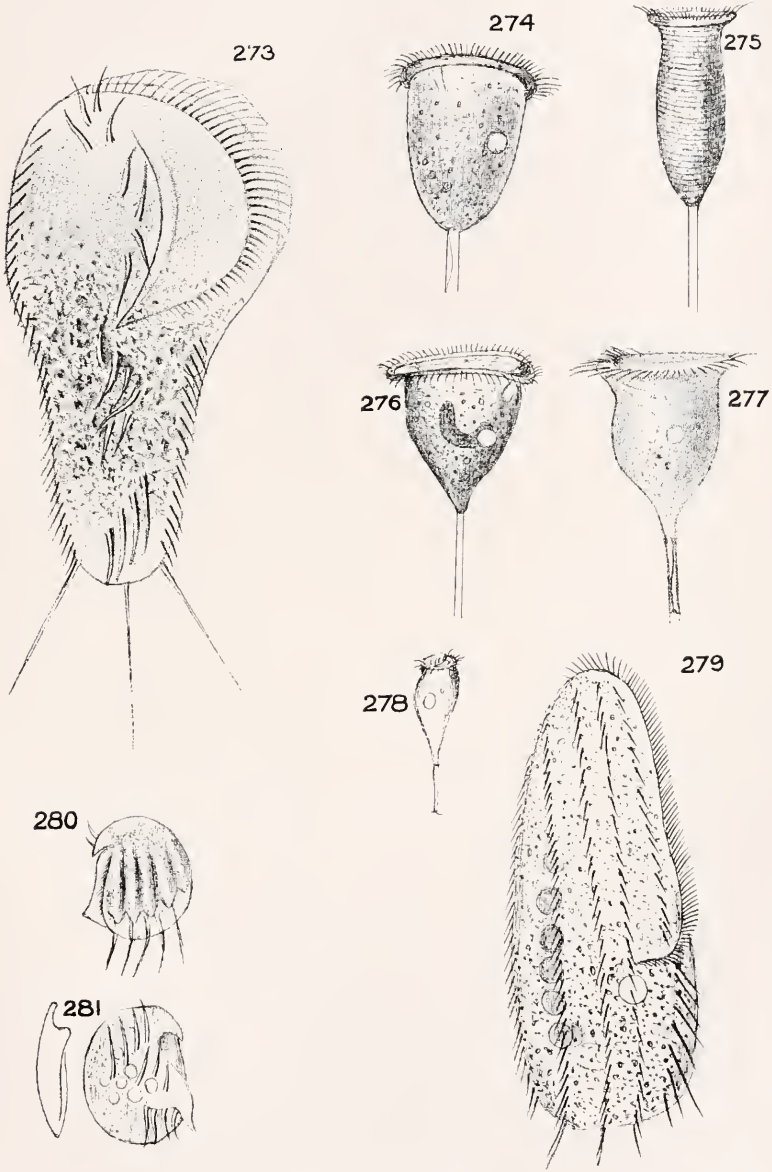
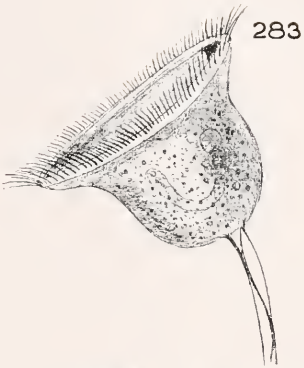
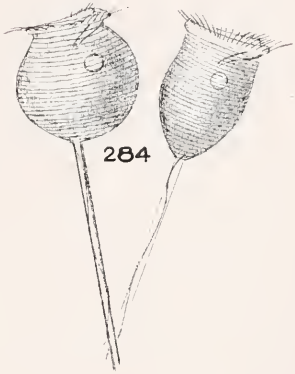


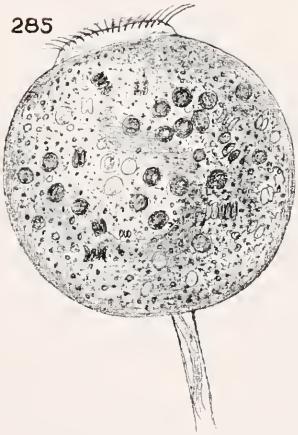
PLATE XXXI; FIGS. 282 TO 286; MAGNIFIED 500 DIAMETERS.

Fig. 282. *Stylonychia fissicia* C. & L.....p. 60
Figs. 283 to 286 are different forms of *Vorticella*....p. 63

PLATE XXXI.







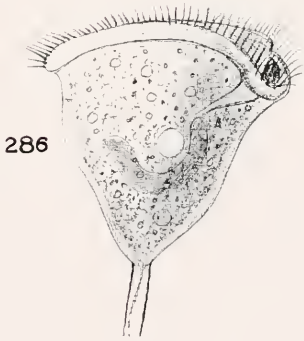


PLATE XXXII; FIGS. 287 TO 292; MAGNIFIED 500 DIAMETERS.*

Fig. 287. *Epistylis flavicans* Ehr. A piece of colony slightly magnified. . . . . p. 64

Figs. 288 and 289 are different members of the colony of *Epistylis* magnified 500 diameters.

Fig. 290. *Pyxidium ramosum* Stokes. . . . . p. 64

Figs. 291 and 292 are forms of *Vorticella*. . . . . p. 63

* Except Fig. 287.

PLATE XXXII.

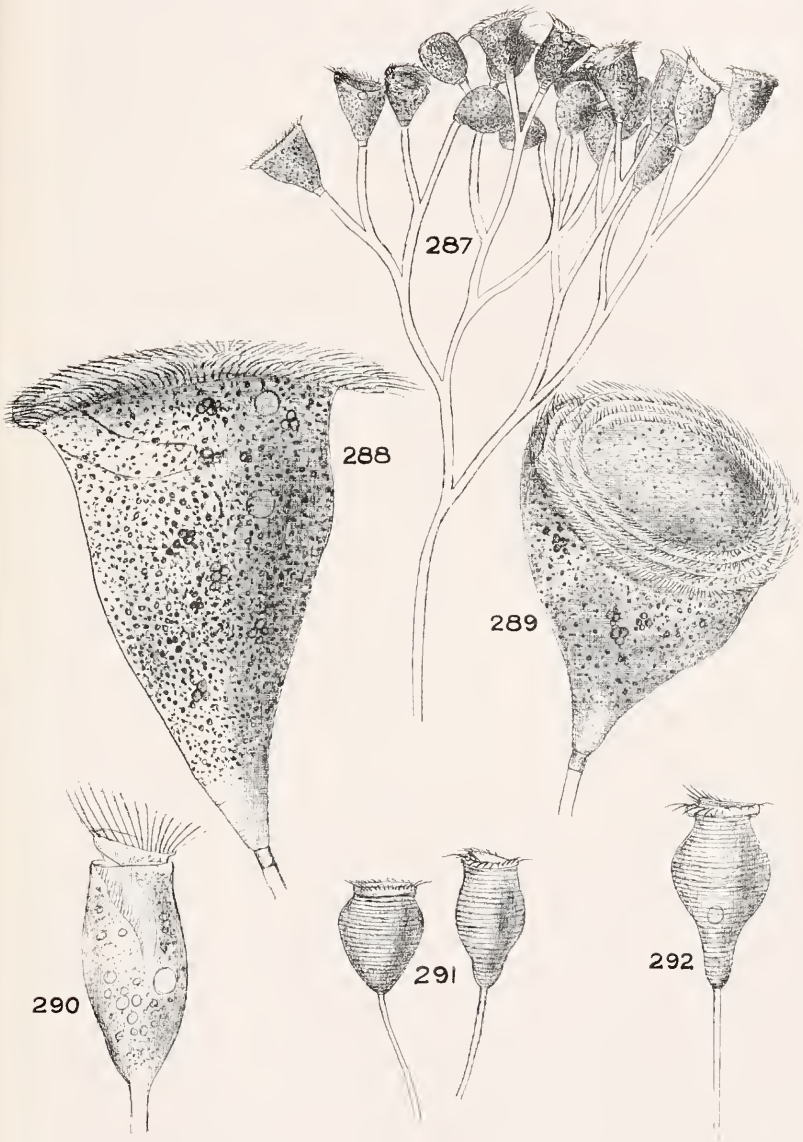


PLATE XXXIII FIGS. 293 TO 298; MAGNIFIED 500 DIAMETERS.

Figs. 293 and 294 are forms of *Vorticella* ..... p. 63

Fig. 295. *Rhabdostyla brevipes* (?) C. & L. This is certainly a different species from Fig. 278 ..... p. 64

Fig. 296. *Vorticella* ..... p. 63

Fig. 297. *Opercularia* sp. (?) *a* is a single individual, and *b* is the form assumed when contracted ..... p. 65

Fig. 298. *Vorticella* ..... p. 63

PLATE XXXIII.

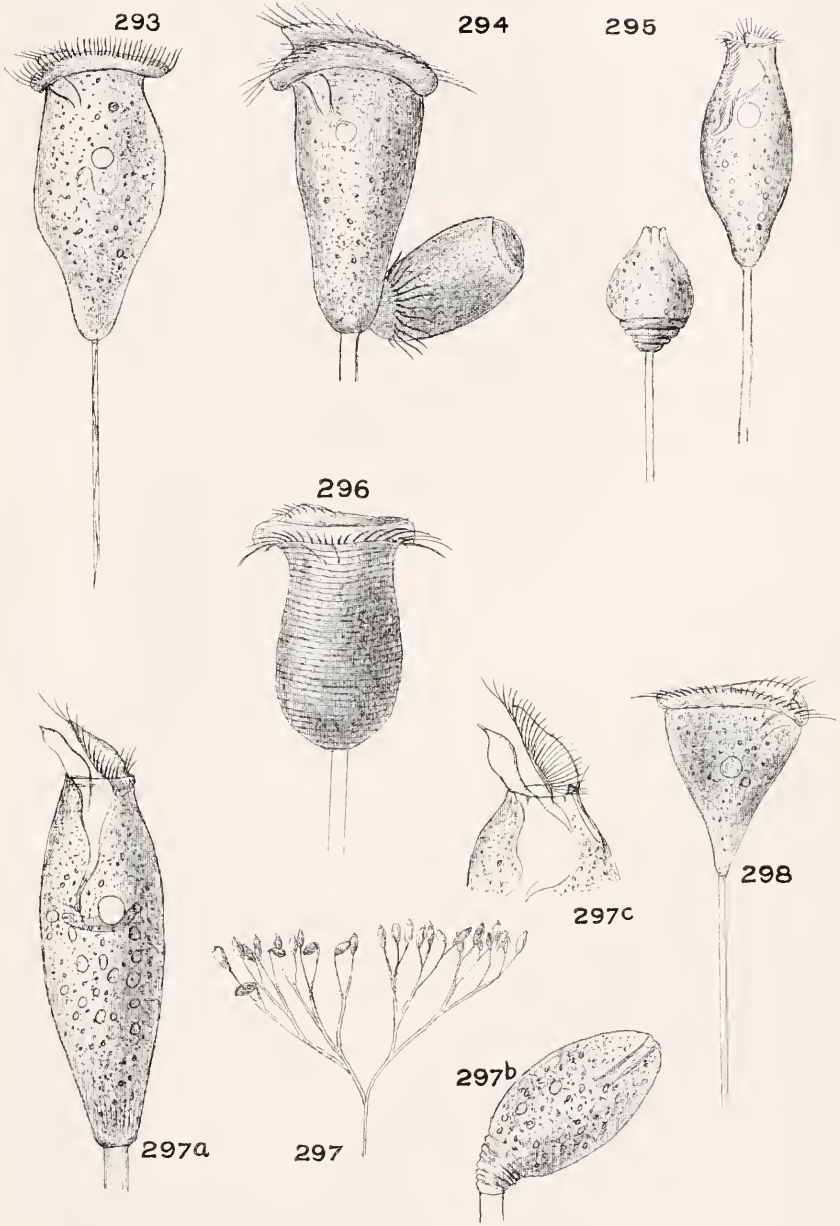


PLATE XXXIV; FIGS. 298 TO 303; MAGNIFIED 500 DIAMETERS.*

Fig. 299. *Carchesium polypinum* Linn. *a* is an expanded colony. *b* is a piece of a single branch magnified so as to show the ending of the individual muscles at the base of each stalk. *c* represents two individuals magnified 500 diameters...p. 64

Fig. 300. *Podophrya* sp. (?) Showing terminal cilia .....p. 66

Fig. 301. *Trichodina pediculus* Ehr.....p. 63

Fig. 302. *Podophrya* sp. (?).....p. 66

Fig. 303. *Sphærophrya* sp. (?).....p. 65

* Except Fig. 299 *a* and *b*.

PLATE XXXIV.